

## Mladen Žinić – *Curriculum Vitae*

**M**LADEN ŽINIĆ was born in Zagreb on 18<sup>th</sup> of April, 1947. He spent his childhood and achieved the elementary education in Trešnjevka, at that time a rather vivid district of Zagreb. As early as in the elementary school he showed the interest in chemistry and joined the chemistry working group which opened him the possibility of making first simple chemical experiments. At the age of 12, he discovered his second love besides the chemistry, playing a guitar, which remained his hobby through entire life. After completing the elementary education with the highest marks, in 1963 he joined the Chemical technical school in Zagreb providing at that time an excellent 4 years secondary level education in chemistry. In 1966 he entered studies of chemistry at the Faculty of Technology (now Faculty of Chemical Engineering and Technology) at the University of Zagreb. In 1971 he graduated with diploma work in organic chemistry and got initially the temporary and soon after the permanent assistant position at the Department of Organic Chemistry of the Faculty of Pharmacy and Biochemistry in Zagreb. In 1974 he received the MSc and 1978 the PhD degree from the University of Zagreb, with both theses in organic chemistry and both being supervised by Professor Dragutin Kolbah from the Faculty of Pharmacy and Biochemistry. In 1977 he moved to ETH Zürich where he spent a postdoctoral year with the Nobel laureate Professor Vladimir Prelog. At ETH he was working on the rather hot topic of enantioselective extraction of amino acid ammonium salts from their racemic aqueous solutions by chiral bifuorene crown ethers and desvalino boromycine. It happened that at that time Jean-Marie Lehn from Strasbourg University was invited guest professor at ETH delivering a series of lectures on his work on supramolecular chemistry. Žinić was so impressed with lectures on the highly exciting new chemistry Lehn was developing that he firmly decided to enter that field upon return in Croatia. After the postdoctoral year, Žinić returned to the Faculty of Pharmacy and soon after (1982) he moved to Podravka-

Belupo Research Institute where he spent 3 years (1982–1985) working on a determination of analytical profiles of drugs and synthesis of selected pharmaceutical entities. In 1985 at the occasion of an informal gathering he was invited by Professor Vinko Škarić from the Ruđer Bošković Institute (IRB) to join his group at the Laboratory of natural compounds and stereochemistry. Žinić immediately accepted the invitation under the condition that he would be allowed to start independent research in supramolecular chemistry which was at that time still in its early stage of development. Professor Škarić bravely agreed with that condition and Žinić joined the group in 1985. In the same year, he was elected to the position of the research associate at IRB. Based on the results of his research in supramolecular chemistry, in 1993 he earned the position of the senior research associate and in 1998 the position of the senior scientist. In 2003, he was appointed to the permanent position of the senior scientist at the Ruđer Bošković Institute. In 1999 he was also appointed as titular full professor of chemistry at the Faculty of Natural Sciences of the University of Zagreb. M. Žinić became the head of the laboratory in 1993 after the retirement of the former head, the academician, Professor V. Škarić. This change also resulted with the change of the scientific focus of the laboratory, from nucleoside to supramolecular chemistry research and accordingly, the name of the Laboratory was also changed to Laboratory of supramolecular and nucleoside chemistry. It should be noted that this laboratory was the first and for a long time the only one active in the supramolecular chemistry research not only in Croatia but also in the wider geographic area. At the Ruđer Bošković Institute, M. Žinić also served as the president of the Council of chemistry in the period of 2002–2004 and also as the head of the Department of organic chemistry and biochemistry. In 2004 he was appointed acting director of the Ruđer Bošković Institute and from 2005 to 2009 he served as Director General of the Institute. In 2004 he was elected an associate member in the Department of



**Figure 1.** Mladen Žinić with Professor Vladimir Prelog; photo taken during his postdoctoral fellowship at ETH Zürich, 1977.

mathematical, physical, and chemical sciences of the Croatian Academy of Sciences and Arts. In 2009 he was appointed a titular full professor of chemistry at the Faculty of Medicine at the University of Rijeka. In 2012 M. Žinić was retired from the Ruđer Bošković Institute. In 2014 he was elected a full member of the Croatian academy of sciences and arts. In 2013 he reactivated and took part-time teaching obligation at the University of Applied Sciences Baltazar. The University is located in Zaprešić, a small town near Zagreb where he lives with wife, Professor Biserka Žinić also organic chemist and scientist from the Ruđer Bošković Institute. M. Žinić's scientific record consists of 115 publications, more than 2700 citations, h-index 28 (Web of Science Core Collection) and 172 contributions, 2800 citations and h-index 29 (Web of Science, All Databases).

His professional activities comprise the memberships in the Croatian, American and Swiss Chemical Societies; in the period 2003–2006 he served as the president of the Croatian Chemical Society. M. Žinić took an active role as a chemistry project reviewer in the Panel of experts at the Academy of Finland. For many years and up to 2008 M. Žinić was the Editorial board member of the *Journal of the Physical Organic Chemistry* (London). He was engaged in the Management Committee of the ESF COST D31 Action Organising

Non-Covalent Chemical Systems with Selected Functions and served as the Croatian representative in the ESF Standing Committee for Physical and Engineering Sciences. On the national level, he was a member of the governing board of the National science, education and technology foundation (2005–2009) and the National council for higher education (2007–2008). M. Žinić was also the member of Organizing or Scientific Committees of the following national and international scientific meetings: XI Meeting of Croatian Chemist Zagreb, 1989.; XV Meeting of Meeting of Croatian Chemist, Opatija, 1997; president of the symposium Vladimir Prelog and Croatian Chemistry, Zagreb, 1996; European Symposium on Organic Chemistry, ESOC, Cavtat, Croatia 2003.

Professor Mladen Žinić substantially contributed to teaching at the PhD studies of chemistry. For many years he served as the head of the Organic chemistry PhD studies at the Faculty of Natural Sciences of the University of Zagreb where he was also providing courses on Organic stereochemistry and Supramolecular chemistry. He was the head of Medicinal chemistry module at the PhD study of Medicinal chemistry organised by the Department of Biotechnology of the University of Rijeka. There he was teaching on Synthesis of natural compounds and design of artificial enzymes and Supramolecular chemistry.

## Scientific work

Mladen Žinić was the first who started supramolecular chemistry research in Croatia and the major part of his work belongs to the research in that field. His group at the Ruđer Bošković Institute became internationally known and much collaboration with the world leading groups in this field was established. The intensive research in supramolecular chemistry in Croatia is clearly related to the establishment of M. Žinić's Laboratory for supramolecular and nucleoside chemistry at IRB in 1993. In the period 1993–2012 a number of scientific papers were published mostly in the highest ranking scientific journals which achieved extensive citation. Žinić's contribution to supramolecular chemistry will be described here in more detail. However, his early research should also be briefly mentioned.

### Early years

The first scientific paper published by M. Žinić describes the comparative  $^1\text{H-NMR}$  study on determination of the *syn/anti* ratio of oximes and 2,4-dinitrophenyl hydrazones by using aromatic solvent induces shift (ASIS) method and newly introduced lanthanide shift reagents (LIS) (*Croat. Chem. Acta*. 1974.). Most of the early research papers are related to synthetic studies on 1,4-benzodiazepines and 1,4-benzodiazepines-2-ones being the major scientific interest of Professor Dragutin Kolbah group at the Faculty of Pharmacy and Biochemistry and collaboration with the group of Dr. Franjo Kajfež (*J. Heterocycl. Chem.*, 1977; 1981). The latter group was very successful and internationally recognised for their achievements in benzodiazepine chemistry mostly due to scientific leadership of Dr. Vitomir Šunjić. Due to interest in Medicinal chemistry, a series of papers describing detailed analytical profiles of selected drugs (zomepirac, piroxicam, pirenzepin and ketotifen) were published in *Acta Pharm. Jugosl.* 1982, 1983). In 1980, Žinić has published in *Tetrahedron Letters* the paper on the synthesis of chiral amino acid containing crown-like macrocycles. This work could be denoted as his first paper in supramolecular chemistry which was the result of his research at the Faculty of Pharmacy and Biochemistry.

### Supramolecular chemistry research

The first paper on supramolecular chemistry with IRB address was published in the *Journal of Organic Chemistry* (1988) describing the preparation of series of macrocycles as ionophore models. The macrocycles were constructed from two (*R*)- $\alpha$ -phenylglycine and a variable number of ethyleneoxy units. It was found that 24-membered macrocycle mimics naturally occurring cyclic ionophores such as valinomycin and nonactin in their ability to transport  $\text{K}^+$  and  $\text{Na}^+$  across the lipophilic membrane. Also, the 24-membered compounds were found to form more stable complexes with water than the equally large crown ethers. Next paper that follows was the result of the

collaboration with Professor Georg W. Gokel from the University of Miami, Coral Gables who became worldwide known for his development of a special type of armed crown ethers, known as lariat ethers. At IRB, chiral lariat ethers with dipeptide arms were constructed. With such lariats, the first enantioselective transport of Z-amino acid (Z = benzyloxycarbonyl) and dipeptide  $\text{K}^+$  carboxylates through chloroform membrane was realised in the simultaneous transport process of both  $\text{K}^+$  and the carboxylate (symport) (*Chem. Commun.* 1990; *Supramol. Chem.* 1992). In the collaboration with V. Škarić and his nucleoside chemistry group two papers were published showing that properly protected and activated 2',3'-secunucleosides could be transformed into chiral lariat or crown ethers by a number of carefully selected synthetic steps (*Tetrahedron Lett.* 1991 and *Helv. Chim. Acta* 1992). In the period 1989–1991 Žinić and Škarić started the collaboration with Jean-Marie Lehn and Jean-Pierre Vigneron from College de France on a European Community Commission project. The project entitled "Synthetic Molecular Receptors for Nucleo Bases, Nucleosides and Nucleotides" was focused on design and synthesis of water-soluble receptors capable to bind biologically important molecules such as nucleobases, nucleosides, and nucleotides in aqueous media. Besides, that research represented also one of the first efforts toward development of supramolecular chemistry in water. The receptors were designed by bridging of two positively charged DNA intercalator molecules such as acridine or phenanthridine (ethidium) with rigid bridges capable to keep the heteroaromatic units close to 3.5 Å distances. The latter is necessary for insertion and binding of planar nucleobase substrates by aromatic stacking interactions and hydrophobic effects. At IRB, the receptors containing bridged phenanthridinium units were prepared and shown to strongly bind selected nucleotides in water with association constants between  $10^5$ – $10^6$   $\text{mol}^{-1}$   $\text{dm}^3$  being the highest known for this type of binding in water (*Tetrahedron Lett.* 1992., *Chem. Commun.* 1995., *Croat. Chim. Acta* 1996.).

Žinić's supramolecular chemistry group at IRB started to grow since 1991 when first doctorands, Leo Frkanec, Predrag Čudić, Sulejman Alihodžić, Ivo Piantanida and very experienced synthetic chemists Dr. Vesna Čaplar, Dr. Milan Jokić, and Dr. Janja Makarević joined the group. Synthetic transformations of phenanthridines were found very difficult at the beginning due to their very low solubility in most of the organic solvents, difficult functionalisation and strong tendency of stacking in the solution. After the progress in synthetic transformations of phenanthridines was achieved they were used for the preparation of fluoroionophores containing fluorophoric 6-phenanthridinyl units attached by a short methylene spacer onto nitrogen atoms of 7,16-diaza- and aza-18-crown-6 rings.

Such fluoroionophores exhibited the ability to signal binding of certain metal cations through the specific complexation induced shifts (CIS) of phenanthridine protons in  $^1\text{H-NMR}$  spectra as well as by the large intensity enhancements in fluorescence spectra. The X-ray structure analysis of  $\text{K}^+(\text{C}_2\text{H}_4\text{Cl}_2)$  picrate complex of 7,16-diaza-crown ether bearing two phenanthridinyl units on crown nitrogens revealed that  $\text{K}^+$  is nine-coordinated, using all donors from the diazacrown ring, one chlorine atom from a 1,2-dichloroethane solvent molecule and both nitrogen donors from *syn*-oriented phenanthridine units. The coordination of  $\text{K}^+$  to phenanthridine nitrogens resulted in strong enhancement of its fluorescence emission (*Tetrahedron Lett.* 1993.). Interestingly, bis(methylenephenanthridinyl) diaza crowns act like fluorescent sensors for metal cations showing by far the strongest increase of fluorescence emission by binding of  $\text{Sr}^{2+}$  and  $\text{Ba}^{2+}$  compared to binding of other cations ( $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{K}^+$ ,  $\text{Na}^+$ ). These results show that besides the recognition of cations by their size, the recognition by their charge density is also realized since  $\text{Sr}^{2+}$  and  $\text{Ba}^{2+}$  possess the sizes comparable to  $\text{K}^+$  and  $\text{Na}^+$  but higher charge density compared to mono positively charged cations.

The concept of a supramolecular catalyst with chiral reaction space was developed and tested on the well-known reaction of cyclopropanation of styrene with ethyl diazoacetate catalysed by chiral  $\text{Cu}(\text{I})$  bisoxazoline complexes. The  $\text{C}_2$  symmetric bisoxazoline was bridged at chiral centres with relatively rigid *p*-alkyl-diphenylmethane bridge; binding of  $\text{Cu}(\text{I})$  and formation of catalytic complex leads to planarization of bisoxazoline unit and induction of helicity in the *p*-alkyl-diphenylmethane bridge. It was found that the cyclopropanation of styrene with ethyl diazoacetate catalysed with such catalytic complex proceeds with good enantioselectivity and considerably improved diastereoselectivity compared to the reaction catalysed by classical acyclic catalytic complex. Improved diastereoselectivity is the consequence of the catalytic transformation that occurred in the helical reaction space (*Chem. Commun.* 2000; *Eur. J. Org. Chem.* 2007). This work was done in collaboration with the IRB's Laboratory for stereoselective catalysis and biocatalysis.

Having bis(phenanthridine) receptors in hand, the highly interesting question on their possible interactions with ss- and ds-oligonucleotides emerged. The observation of recognition events in such studies may give novel fluorescent probes for DNA/RNA structure and sequence domains. In Žinić's laboratory, the methodology and techniques for binding studies of small molecules with oligonucleotides were developed in collaboration with Professor Hans Jörg Schneider from Saarland University. So, the bis(phenanthridine) receptor story further developed toward binding studies of this type of compounds with various types of ss- and ds-oligonucleotides. The lion's

share of the research belongs to Dr. Ivo Piantanida, Lidija Marija Tumir, and Marijana Radić Stojković. Flexible mono-bridged and rigid double-bridged bis(phenanthridinium) receptors with positive charges on phenanthridine nitrogens were prepared and their interactions with oligonucleotides were studied by using various methods including, UV and fluorescence spectroscopy, NMR, thermal melting experiments, and viscosimetry. Generally, flexible singly bridged molecules showed intercalative binding to ss- and ds-oligonucleotides while the rigid double bridged molecules preferably bind by intercalation to ss-oligonucleotides and by non-intercalative binding (electrostatic or groove binding) to ds-oligonucleotides (*Tetrahedron*, 2004). Double bridged ligands differentiate AMP from GMP or UMP by significant fluorescence emission increase upon complexation of the first nucleotide in water ( $\log K_s$  of 1:1 and 1:2 complexes 5.8 and 1.4, respectively), while only a slight emission change is observed in titrations with GMP and UMP. As the next step, mono- and di-charged 4,9-diazapyrenium and bridged bis(4,9-diazapyrenium) molecules possessing larger aromatic surface than phenanthridinium molecules were prepared and their affinities toward ss- and ds-oligonucleotides assessed. In some cases, specific fluorescence response was observed for binding with poly AU (increase) and poly GC (decrease) oligonucleotides while with poly U strong increase of helicity was observed together with a high association constant. Generally, this type of molecules exhibits mostly intercalative type of binding essentially independent on the number of charges present in the ring system. The latter is in line with negligible electrostatic binding contribution and with the corresponding affinities towards nucleotides. The monofunctional compounds exhibit some noteworthy RNA selectivity and some derivatives showed strong anticancer activity *in vitro* (*J. Chem. Soc., Perkin Trans. 2*, 2000; *Chem. Soc., Perkin Trans. 2*, 2000; *J. Chem. Soc., Perkin Trans. 2*, 2001. *Tetrahedron Lett.* 2001; *Tetrahedron* 2004., *Cancer Chemother. Pharmacol.* 2008).

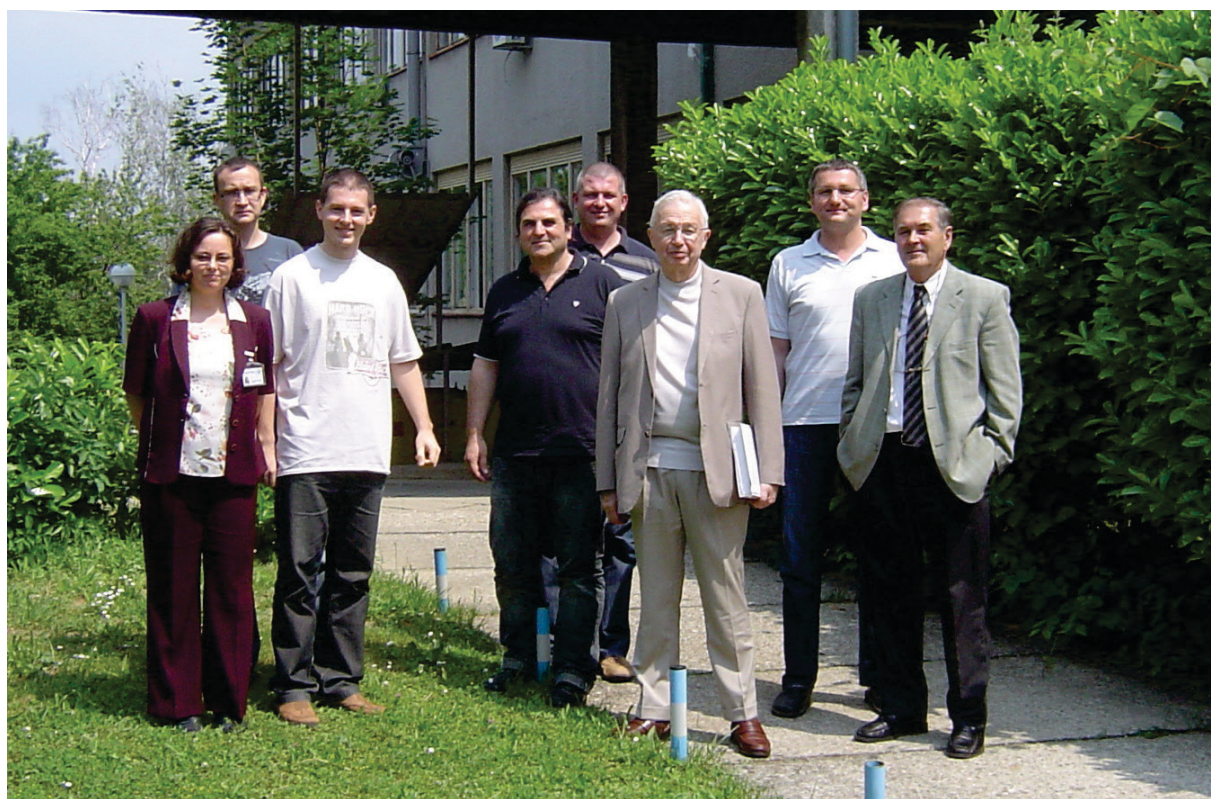
With the idea to accomplish selective ss-DNA or ss-RNA intercalative binding and recognition of complementary base domains, a novel phenanthridinium–nucleo base conjugates were synthesized by attachment of alkyl-nucleo base fragment onto the phenanthridinium 2-amino nitrogen. It was found that adenine containing conjugates exhibit specific spectroscopic changes and two orders of magnitude higher affinity toward poly U than uracil conjugates. The latter is due to the existence of specific interactions between adenine and uracil, possibly Watson-Crick hydrogen bonding between the bases stacked on the phenanthridinium surface (*Chem. Commun.* 2002). NMR, UV and fluorescence studies of the conjugates in aqueous media revealed intramolecular aromatic stacking

interactions between the phenanthridinium unit and the nucleobase, due to the conformation of the molecules. Some of the conjugates are capable to form intercalative-type 1:1 complexes with the nucleotide aromatic unit inserted between phenanthridinium and covalently attached nucleobase, yielding binding constants of  $10^3$ – $10^4$  mol<sup>-1</sup> dm<sup>3</sup> (*J. Phys. Org. Chem* 2002). Permanently charged *N*-methyl-8-aminophenanthridinium-uracil and -adenine conjugates possessing a nucleobase attached at the phenanthridinium 8-amino group by a trimethylene spacer were prepared in the form of water-soluble hydrogen-sulphate salts. Spectroscopic characteristics of the conjugates reveal the formation of folded conformations in water characterized by intramolecular aromatic stacking between the phenanthridinium unit and the tethered nucleobase. No recognition of complementary nucleotides was achieved in binding studies with this type of conjugates as well as no preference of conjugates to ss-poly-nucleotides containing complementary nucleobases was observed. However, at pH = 5, the *N*-methylphenanthridinium-adenine conjugate exhibited preferred binding to double-stranded (ds-) polyAH(+), whereas its protonated analogue bound preferably to polyU. The results reveal that the presence of protonated or permanently charged intercalator units in the conjugates dramatically changes their binding preferences for polynucleotides (*J. Phys. Org. Chem.* 2003). It was also shown that bis-uracil-phenanthridinium conjugate stabilized significantly more effectively poly-dA - poly-dT and poly-AH(+)-poly-AH(+) than its adenine analogue. For the alternating poly-dAdT-poly-dAdT however, the binding preference is lost, pointing to the importance of specific interactions of uracils of the conjugate with homopolynucleotides containing consecutive adenines (*Chem. Commun.* 2005).

Discovery of calix[4]arenes by Carl David Gutsche from Washington University, St Louis in the seventies of the last century resulted in an intensive use of synthetically modified calixarenes as receptors, carriers and enzyme models. In the Žinić's group at IRB (Dr. Leo Frkanec), peptidocalixarenes a chiral calix[4]arene derivatives with four *O*-(*N*-acetyl-PhgOMe), (Phg denotes *R*-phenylglycine), or *O*-(*N*-acetyl-LeuOMe) strands at the lower rim have been synthesised. Calix[4]arene derivatives with one OCH<sub>2</sub>COPhgOMe and two OCH<sub>2</sub>COPhgOMe strands and with 1,3-OMe-2,4-(O-CH<sub>2</sub>COPhgOMe) strands at the lower rim have also been prepared. For the derivatives with 4 lower rim strands, it was found that compounds in chloroform solution form the stable cone conformation with a non-covalently organised cavity at the lower rim formed by circular inter-strand amidic hydrogen bonds. Such organisation was found to affect their selectivity and extraction/transport properties of metal cations. The solid-state and solution structures of the 4-strand derivative and

its NaClO<sub>4</sub> complex were found identical, C<sub>4</sub> symmetric cone conformations. Publication of this work is related to a rather interesting story. This quite extensive paper was published in 2000 in the vol. 6 of, at that time, new European journal named *Chemistry – A European Journal* which was founded by the initiative of Jean-Marie Lehn and some other European chemists. In accord with the spirit of the united Europe, the Editorial Board of the journal stimulated preparation of Abstracts in various European languages. Since the paper on calixarenes was authored solely by Croatian researchers the Abstract was submitted and accepted in Croatian. This is most probably the only example of the publication in the high ranking international scientific journal that contains abstract in the Croatian language. Recently, in collaboration with the Faculty of Science (University of Zagreb) group (Professor Vladislav Tomišić, Professor Leo Frkanec *et al.*) stability constants for various metal ions are precisely determined (*J. Incl. Phenom. Macrocycl. Chem.* 2005), and new fluorescent calix[4]arene derivatives were synthesized by introducing phenanthridine moieties at a lower calixarene rim. It was shown that due to the prominent fluorescence of some of these compounds they could be considered as potential sensitive fluorimetric cation sensors (RSC Advances 2015).

In 1995 professor Kenji Hanabusa from Shinshu University, Nagano, begins to publish a series of papers, mostly in RSC *Chemical Communications*, which describe various low molecular weight organic compounds capable to gel diverse liquids such as organic solvents, vegetable oils, hydrocarbon fuels, and water. The reports on gelling were mostly phenomenological lacking any explanation of the gelation mechanism. Žinić's research group at IRB entered the gel research very early being among the first European groups. Gel research topic became the major research direction in Žinić's group in the period since 1995 up to 2012 when he was retired from IRB. The results of this research were based on the discovery of bis(amino acid or amino alcohol)oxalamides as highly versatile gelators of both, polar and apolar solvents and water. The results of Žinić's gel research significantly contributed to better understanding of gelation and he has shown that gelation is, in fact, the supramolecular phenomenon. In the *Chem. Eur. J.*, 2001 paper it was shown that gelation is based on the predominantly unidirectional self-assembly of the self-complementary organic molecules into nano-sized fibers. The fibers subsequently entangle and form the gel network capable of immobilizing present solvent (*Chem. Commun.*, 1995.; *Chem. Eur. J.*, 2001; *Chem. Commun.* 2002; *Chem. Eur. J.* 2003; *Chem. Commun.* 2004). The *Chem. Eur. J.*, 2001 paper explaining the supramolecular nature of gelation is cited 180 times and the citation continues even 16 years after its publication. More advanced gelation system was developed in Žinić's laboratory based on



**Figure 2.** Meeting of Nobel laureate Jean-Marie Lehn with Croatian macrocyclic and supramolecular chemistry group during the visit IRB 2011 (from left to right Ivana Antol, Nikola Basarić, Vjekoslav Štrukil, Leo Frkanec, Vladislav Tomišić, Jean-Marie Lehn, Zoran Džolić and Mladen Žinić).

photochemical bis(amino acid)maleic (nongelling) to fumaric amide (gelling) isomerisation at the molecular level that occurs in water at room temperature. The system involves the transformation at the supramolecular level exemplified by macrospheres (maleic amide) transformation into gel fibers (fumaric amide) under kinetic control at the molecular level (*J. Am. Chem. Soc.* 2002.).

It was shown for the first time that highly interesting gelation properties could be found in the mixed gelator systems which represent the supramolecular variant of the molecular co-polymerisations. The pronounced chirality effects were found in the mixed gelator systems consisting of homo- and hetero-chiral combination of the constitutionally different gelators. In some cases, the homo-chiral combination was capable to gel much higher volumes of certain solvent than the hetero-chiral combination (*New J. Chem.* 2006).

Also, the issue of positional isomerism and its influence on gelling efficiency was addressed for the first time in the *Chem. Eur. J.* 2010 paper. The importance of the positional isomerism on gelling efficiency is illustrated by the fact that in some cases, one positional isomer is capable to gel up to a 70-time larger volume of the solvent than the other isomer.

Within European cooperation in science and technology (COST) network, Action D31 Organising Non-Covalent Chemical Systems with Selected Functions (2004–2009) cooperation with the eminent research groups was achieved. Should be pointed out two significant reviews related to the gels topics was made in cooperation with the group of professor Fritz Vögtle, University of Bonn (Topics of Current Chemistry 2005). Furthermore, in cooperation with the group of professor Jean-Luc Pozzo, University of Bordeaux, was used 11-aminoundecanoic acid as a synthetic building-block for preparation of (oligo)amide organogelators including chiral ones which display remarkable gelation properties in organic solvents and water (*Chem. Commun.* 2004).

The contribution of M. Žinić's group to gel research topic in the period 1995–2010 was internationally recognised which resulted with an invitation from the RSC *Chemical Communications* journal for the preparation of a Feature Article on oxalamide gelators (L. Frkanec and M. Žinić, *Chem. Commun.* 2010).

In the last period of M. Žinić's research, more complex gel systems were designed and studied. In collaboration with Liz-Marzan group from Vigo University, Spain,

helical gel fibers were used for adsorption of gold nanorods. It was demonstrated for the first time that the chiral three-dimensional arrangement of nanorods on the surface of helical gel fibers leads to the appearance of extremely strong surface plasmon enhanced circular dichroism (*Angew. Chem. Int. Ed.* 2011). The observed phenomenon could be used for sensing of chirality in biological systems. Gelators containing central and axial chirality in the molecule have been prepared. In contrast to molecular systems where central to axial chirality transfer occurs by intramolecular mechanism through short distances between chiral centre and biphenyl unit (usually 3 bond distances) here the transfer occurs by self-assembly of gelator molecules (intermolecular mechanism) despite 9 bond distance between the chiral centre and biphenyl unit (*Chem. Commun.*, 2012). Gelators constructed from two amino alcohol oxalamide fragments and a biphenyl unit were found to form two gel systems depending on gelator concentration: one at equilibrium and the second one out of equilibrium existing for a very long time period of 216 hours. The later highly complex system involves central to axial chirality transfer, diastereoisomer interconversion, self-sorting and coupled equilibria (*Eur. J. Org. Chem.* 2016).

In addition to work mentioned in the above research outline, Nataša Šijaković Vujičić, Tomislav Portada, and Tihomir Pospíšil also significantly contributed to some specific research themes, and their names can be found in the List of Publications within this issue of *Croatica Chemica Acta*.

Professor Mladen Žinić was the first scientist who started and successfully developed research in supra-

molecular chemistry in Croatia. His scientific contribution in this field was recognised at the international and national level. International recognition emerges from a high citation of his work and publications in the leading international scientific journals as well as from many invitations to lecture at distinguished scientific conferences and universities in Europe. At the national level, many young researchers were educated and acquired their MSc and PhD degrees under the supervision of Professor M. Žinić. His contributions to the PhD studies of organic and medicinal chemistry at Universities of Zagreb and Rijeka may be denoted substantial due to the introduction of supramolecular chemistry courses in their curricula. In addition, two laboratories at the Ruđer Bošković Institute are founded which continue the research in various topics of supramolecular chemistry being headed by his former collaborators Dr. Ivo Piantanida and Dr. Leo Frkanec. Besides his highly successful research, he also served in many international scientific bodies as the representative of Croatia and national councils and institutions dealing with science and higher education. For his work he was awarded with the National Award for Science 2001, Croatian Academy of Sciences and Arts award for science 2002, Award of the city of Zaprrešić 2002 and the Award of Zagreb County for life achievements in 2009.

*Prof. Dr. Leo Frkanec*  
*Prof. Dr. Davor Margetić*  
*Prof. Dr. Dražen Vikić-Topić*