

Conference Report

40 Years of Surface Science and Nanotechnology (40Nano)

Congresso Stefano Franscini (CSF), Ascona, October 15–20, 2023

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Fig. 1. The Announcement Poster of 40Nano.

Celebrating the 40th anniversary of the scanning tunneling microscope (STM), the 40Nano Conference unfolded in October 2023 at the Congresso Stefano Franscini (CSF), Monte Verità, Ascona. Beyond this milestone, the event acknowledged nearly four decades of dedicated service by the conference chair in the field of surface science. Attendees were warmly welcomed on Sunday night, with the chair considering them as his ‘other family’. The five-day program featured 25 invited talks and 26 contributed talks, presenting a diverse array of surface nanotechnologies. These discussions not only highlighted new developments but also emphasized the significant progress made over the past decades.

The Sunday night session took off with a talk by Nobel laureate **Ben Feringa** (Fig. 2) from the University of Groningen. After SAOG in Fribourg in 2019, *Chirality @ The Nanoscale* in Ascona in 2019,^[1] and the SASP22 in St. Moritz in 2020,^[2] 40Nano marked the fourth occasion we successfully brought him to Switzerland for a scientific meeting. This time Ben focused on synthesis and self-assembly of molecular switches and motors on surfaces for creating molecular ‘wind-mill parks’. The second speaker of the evening, **Ulrike Diebold** (TU Vienna) reported on the important role that atomic force microscopy (AFM) played in the last three decades for structure evaluation of oxide surfaces.



Fig. 2. Ben Feringa lecturing at Monte Verità.

In his Monday morning presentation, **Charlie Campbell** (University of Washington, Seattle) underscored the pivotal role of surface science tools in advancing the development of superior heterogeneous catalysts. Following this, **Andrew Gellman** (Carnegie-Mellon, Pittsburgh) delved into chiral surface chemistry. In his contribution he showed that decomposition chemistry of tartaric acid proceeds with high enantioselectivity on surfaces with opposite handedness. **Roman Fasel** (Empa) took center stage to discuss gra-

phene nanomaterials, exploring the manifestation of magnetism in extended π -electron systems through topological constraints.

In the Monday afternoon session, **Junfa Zhu** (USTC Hefei) discussed on-surface chemistry with coinage metal surfaces, utilizing Ullmann, Glaser, and Sonogashira coupling reactions. **Katharina Franke** (FU Berlin) followed, highlighting the physics of single magnetic atoms on superconducting surfaces and in Josephson junctions.

The Tuesday morning session began with **Thomas Bürgi** (University Geneva) unveiling remarkable dynamics in chiral gold and silver nanoclusters. Subsequently, **Daniel Bürgler** (Peter-Grünberg Institute, Jülich) explored enantioselective adsorption phenomena of chiral helicenes on ferromagnetic cobalt nanoislands.

Maki Kawai, the former president of the Chemical Society of Japan and current president of the Japanese National Institutes of Natural Sciences (NINS), discussed the manipulation of single molecules with STM. Through inelastic electron tunneling, molecules undergo vibrational excitation and exhibit various dynamic responses, including hopping, rotation, desorption, and chemical reactions.

Twisted crystals emerge in response to high crystallographic driving forces, as **Bart Kahr** (New York University) elucidated through compelling optical and electron micrographs of a diverse range of materials. **Michael Gottfried** (Philipps-University Marburg) introduced novel carbon allotropes generated by on-surface chemistry, characterized using scanning probe methods (SPM).

Wednesday morning focused on advancements in the study of the mechanical properties of proteins. **Viola Vogel** (ETH Zurich) detailed how cells utilize protein stretching to sense mechanical stimuli, while also proposing new nanosensors to aid in the comprehension of these processes. **Henry Hess** (Columbia University, New York) presented innovative hybrid nanodevices built on microtubules and motor proteins like kinesin. **Tibor Kudernac** (University Groningen) introduced the engineering of artificial microtubules, drawing inspiration from principles observed in cellular microtubules.

Wednesday afternoon featured **Helmut Zacharias** (University Münster) discussing electron spin-filtering on helicene monolayers, revealing chirality-induced spin selectivity effects. **Ron Shen** (UC Berkeley) (Fig. 3) highlighted the surface sensitivity of second-order non-linear optical techniques, allowing for the recording of electronic and vibrational spectra in buried interfaces.



Fig. 3. Ron Shen (UC Berkeley), pioneer in nonlinear optics, explaining selection rules of sum-frequency generation (SFG) spectroscopy.

The standout moment of the meeting undoubtedly revolved around the public lecture delivered by **Philippe Jetzer** (Fig. 4) from the University of Zurich, which was exclusively organized for the Ascona community. Typically, public talks draw only a small number of locals. However, in this particular instance, the turnout surpassed expectations. Perhaps the engagement was heightened because the lecture was presented in Italian by a native of Ticino. Additionally, the captivating subject, titled ‘Onde gravitazionali: una nuova finestra per l’esplorazione dell’Universo’, contributed to the remarkable attendance, with over 70 villagers making their way up to Monte Verità.



Fig. 4. Public lecture on gravitational waves by Philippe Jetzer (Institute of Physics, University of Zurich).

Magnetism of polyaromatic hydrocarbons was the subject of **Pavel Jelinek’s** (Czech Academy of Sciences) contribution. Polyradical molecules were inspected using scanning probe microscopy (SPM) as well as many-body calculations. **Wolf-Dieter Schneider** (EPF Lausanne) delivered a tutorial lecture on the spectroscopic manifestations of the Kondo effect, wherein magnetic impurities induce spin-flip scattering of conductance electrons on metallic surfaces. Reactivity and self-assembly of helicenes on metal surfaces played a role once again, this time in the talk by **Narcis Avarvari** (University of Angers). He demonstrated that their exceptional chiroptical properties, related to their helical π -conjugated skeleton, make them excellent candidates for organoelectronic devices.

Tip-enhanced Raman spectroscopy, blending the spatial resolution of STM with chemical insights, was demonstrated by **Nan Jiang** (University of Illinois Chicago). This technique proved effective for identifying individual molecules and characterizing single defects in two-dimensional materials. **Andreas Terfort**

(Goethe University of Frankfurt) covered more than self-assembled monolayers as templates for the growth of metal-organic frameworks. He highlighted the versatility of free-standing membranes obtained through self-assembly, on-surface processing, and lift-off from surfaces. These membranes were showcased as valuable supports for transmission electron microscopy and graphene derivatives with intriguing electronic properties.

On Friday morning, **Jay Siegel** (Tianjin University) delved into the significance of collectively acting van der Waals interactions in chemical phenomena, including phase behavior, crystal packing, and supramolecular coordination chemistry.



Fig. 5. Leo Gross of IBM Zurich explained the potential existence of unpaired electrons in planar aromatic molecules.

In addition to the invited lectures, a range of topics were covered in contributed talks by established scientists, PhD students, and post-docs (Figs. 5 & 6). To name a few, **Josef Michl** (U Colorado) presented the synthesis of 2D metalloporphene polymers on water surfaces, **Vera Hubert** (Swiss National Museum) introduced the use of X-rays in cultural heritage science and art conservation, and **Egzona Neziri** (PhD candidate University of Zurich) reported on ferromagnetism in 2D metal-organic frameworks. Single atom magnetism and quantum coherence between two or three atoms as qubits for potential quantum computing was a hot topic, covered in talks by **Harald Brune** (EPF Lausanne) as well as **Valeria Sheina** and **Soo-hyon Phark** (both from QNS Seoul). Two well-attended poster sessions further enriched the conference (Fig. 7).

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Fig. 6. Michelle Randall, Director of Operations of the IBS Center for Quantum Nanoscience in Seoul, Korea discusses the cultural onion.



Fig. 7. Attendees from QNS in Seoul, Korea posing with the conference chair.

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- [1] K.-H. Ernst, *CHIMIA* **2019**, *73*, 1042, <https://doi.org/10.2533/chimia.2019.1042>
 [2] K.-H. Ernst, *CHIMIA* **2020**, *74*, 509, <https://doi.org/10.2533/chimia.2020.509>



Fig. 8. Attendees of the 40 Years of Surface Science and Nanotechnology (40Nano) Conference at Monte Verità above Lago Maggiore.



Fig. 9: Impressions from the 40Nano conference (Photography by M. Gottfried and K.-H. Ernst).