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Editorial

Special Issue "Recent Developments on Functional Coatings for Industrial Applications"

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Abstract: "Recent Developments on Functional Coatings for Industrial Applications" assessed some emerging aspects concerning the recent research progress in the designing, manufacturing and tailoring of new functional coatings for industrial applications. The purpose was to address the recent development in functional coatings synthesis, characterization and optimization, highlighting its emerging industrial applicability in many industrial fields, such as self-healing, self-cleaning or sustainable energy technologies. The multidisciplinary nature of the issue represents an added value aimed at better enhancing the practical relevance and the technological versatility of the functional surface engineering design.

Keywords: coatings; synthesis; characterization; energy saving; surface texturing

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Functional coating technology has acquired, in recent years, increased attention due to its effective potential for improved engineered materials. Indeed, a conventional coating is applied on a surface to offer protection from only environmental actions or for decorative properties. Recently, the growing request for new materials with synergistic properties pushed the research toward a new field to obtain innovative and smart coatings with functional capabilities that greatly differ from the conventional ones. In such a context, the "functional coatings" expression has acquired specific relevance.

These "materials" can be classified into several categories depending on their formulation, synthesis or the functional characteristics developed for specific use conditions. Depending on the required performance or application, functional coatings can be asked for several properties, such as: durability, chemo-thermal stability, specific surface morphology, environmental sustainability [1].

In such a context, recent and emerging industrial applications of functional coatings are used in several and apparently dissimilar fields: from the biomedical [2] or electronic industries [3], to aerospace and automotive transportation [4] as well as in sustainable energy technologies [5].

The purpose of this Special Issue is to assess the on the edge development in this research areas for the improvement and growth of actual performance, industrial scale-up and marketability of functional coatings.

In particular, this Special Issue contains six research articles and two review articles. A novel blocked isocyanate crosslinker for the low-temperature curing of automotive clearcoats was reported by June et al. [6]. The results evidenced that a low-temperature curing clearcoat can be tailored by tuning the curing temperature and reactivity of an isocyanate crosslinkers blocked with pyrazole-based substituents. The interest of the automotive sector in new technologies, in the field of functional coatings, was confirmed by the paper by Aranke et al. [7], who realized an extensive and detailed review on coatings for automotive gray cast iron (GCI) brake discs. In particular, this review assessed the traditional and emerging coating technologies for GCI substrate for brake disc applications highlighting, comparatively, pros and cons of the different industrial choices.

Calabrese et al. [8] assessed, in a review, the barrier and self-healing properties of zeolite-based composite coatings. Based on literature results, a property–structure relationship for these functional coatings was proposed. The review was extended, summarizing the competing active and passive protective mechanisms involved in the anti-corrosion performances of the coating.

Fernandez et al. [9] assessed corrosion protection performances in a ternary chloride molten salt of a natural coating on alumina-forming alloy, as potential material in thermal energy storage for concentrated solar power (CSP) technology. The results highlighted an interesting barrier action of alumina-forming alloys in these critical environmental conditions. Moreover, the paper proposed by Frontera et al. [10] was oriented on sustainable energy technologies. In particular, the authors prepared and characterized an innovative adsorbent coating for the adsorber unit of an adsorption heat pump. The composite coating was obtained by the electrospinning of polyvinylpyrrolidone (PVP) solutions added with different quantities of tetraethyl orthosilicate (TEOS). The results demonstrated that TEOS concentrations in the range of 5–13 wt.% produced microfibre coatings of non-woven textile structure with both good thermal stability and high permeability, representing a significant advantage in adsorption systems.

In their paper, Rahmati et al. [11] proposed a plasma electrolytic oxidation (PEO) coatings grown (by-layer structure constituted by MgO, MgF_2 and Mg_2SiO_4 phases) on AZ31 Mg alloy in a silicate-based electrolyte containing KF using unipolar and bipolar waveforms. It was observed that the anti-corrosion properties of the coatings, evaluated in 3.5 wt.% NaCl solution, are mainly related to the compact inner layer, evidencing that coatings produced by soft-sparking waveforms provided the highest corrosion performance.

In a further paper, Calabrese et al. [12] synthesized a super-hydrophobic surface with a coupled micro- and nano-textured surface on a 6082-T6 aluminum substrate by using three different surface pre-treatment approaches: (i) boiling water treatment, (ii) wet chemical etching in HNO_3/HCl solution, (iii) wet chemical etching in HCl and HF solution. The most promising results were observed for the HF-etched surface that showed a water contact angle (WCA) above 175°. Finally, an interesting correlation between hydrophobic behavior and surface texture was addressed.

Finally, in Pizzanelli et al. [13], nanocomposite films based on poly(vinyl butyral) (PVB) and antimony-doped tin oxide (ATO), both uncoated and surface-modified with an alkoxysilane, were prepared by solution casting at varying filler content (from 0.08% to 4.5%). The solar direct transmittance and the light transmittance, determined according to CEN EN 410/2011, clarified that the performance of these films is suitable to be applied as plastic layers in laminated glass for glazing.

This Special Issue is useful for providing researchers who are approaching this application context with a profitable increase in knowledge, with the aim of giving valuable scientific support on possible new research paths concerning functional surface engineering design and tailoring.

Conflicts of Interest: The authors declare no conflict of interest.

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