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Editorial: New Pigments and Additives for Corrosion Protection by Organic Coatings

Flavio Deflorian[1]*, *Michele Fedel*[1] *and Victoria Johnston Gelling*[2]

[1] *Department of Industial Engineering, University of Trento, Trento, Italy,* [2] *Department of Coatings and Polymeric Materials, North Dakota State University, Fargo, ND, United States*

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Editorial on the Research Topic

New Pigments and Additives for Corrosion Protection by Organic Coatings

Corrosion protection of over- and under-ground structures as well as industrial products by protective coatings is one of the most widely employed methods. The durability of the protective coatings is commonly prolonged thanks to the addition of pigments or specific compounds which are able to provide the substrate with improved corrosion protection. During the past 20 years, the field of corrosion protection science and technology has developed, produced, and tested a variety of novel pigments and compounds whose full potential as well as their long-term efficiency are as yet unknown. Pigments in paints are not only added to improve the barrier properties but they can be designed also to provide passivation, galvanic protection, pH buffering, or self-healing of the polymeric matrix. Corrosion inhibition can be achieved by adding to the polymeric matrix partially soluble pigments or stimuli sensitive reservoir of chemical species in which the leakage depends on an electrochemical or chemical trigger. Along with the development of modern paints, technologists have been also focused on new pigments for the development of the so called "smart coatings." These new coatings are to address the environmental concerns related to traditional pigments and compounds (such as chromates and phosphates), to provide self-healing and to improve the longevity of the coatings. This objective can be accomplished by combining the polymeric phase with innovative pigments/compounds with tailored properties. In this frame, there is a significant ongoing research seeking to improve the functionality of protective pigmented organic layers often employing a nanotechnology based approach.

This special issue of the Frontiers in Materials–section Environmental Materials—is motivated by the need to update the state-of-the-art in the development of completely new pigments for corrosion protection and to establish a milestone by taking a snapshot of the efficiency of the current cutting-edge solutions.

The ten papers in this collection give an in-depth picture of the state of the art and future developments in the field of new pigments and additives for corrosion protection by organic coatings, coming from research groups from around the world engaged in research in this area. Two articles in particular are interesting as they present an accurate review of the new generation of nano-composites for corrosion protection (Bao et al.) and on methods of assessment of protective performance in this field (McMahon et al.). In fact, it is important to emphasize that innovation in this area, on one side, involves the development of new materials, but also needs accurate and scientifically rigorous evaluation and verification methods to predict their behavior in the field. Still considering the methods of investigation, the article by Nazarov et al. provides an focus on the use of one of the most powerful electrochemical techniques in this area, namely the use of the Scanning Kelvin Probe.

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***Correspondence:**
Flavio Deflorian
flavio.deflorian@unitn.it

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The other articles are more focused on the development of new protective systems based on organic coatings with new pigments, where nanotechnologies already play a fundamental role, and will be even more relevant in the future.

One of the most advanced technology for corrosion protection by coatings is the use of microcapsules, with inhibitors inside, able to stop the corrosion and having a self-healing capability or containing chemical compounds polymerizing and repairing the scratches. A first example of a protective system based on microcapsules containing chemicals compounds with inhibitory action is the paper by Karaxi et al.

The paper of Cotting et al. represents a study that develops a new coating with self-healing capacity thanks to the chemical properties of microcapsules that polymerize in the event of damage to the coating itself.

Inorganic pigments, which are traditionally used in organic coatings, are showing relevant developments in particular at nano-scale, giving a relevant contribution to innovation in this area, as shown in the case titania nanopigments in the paper of Shafaamri et al. Also conductive polymers, extensively studied in the last decade to develop new composite coatings for corrosion protection, are promising materials as demonstrated in the paper by Jadhav et al.

One of the more effective driving forces for innovation in pigments for organic coatings for corrosion protection are the environmental issues associated with most of the corrosion inhibitors currently used in industry. Several pigments used in the past have a significant impact on the environment and human health and must be substituted. A way to find new environmentally friendly products is to give a look to the natural biological products and use it as additives in coatings. This is the approach of the paper of Zhang et al., using mussel proteins as effective additives in organic coatings.

A further, very relevant, field of innovation is the development of multifunctional coatings. The concept can be considered from different points of view. In some cases, multifunctional coatings can be considered materials using more than one strategy for improving corrosion protection. An example is the paper of Castaneda et al., where both Zn particles and nanotubes are employed in organic coatings to reduce the risk of microbiologically induce corrosion. Moreover, the traditional, and still essential, function of the pigments, to contribute to the corrosion protection action of the organic coatings, is sometime combined with new technological functions. An example of this new trend in multifunctional coatings is the paper of Miszczyk where nano-sized ferrites are studied to improve coating durability, but also to act as microwave absorber.

This collection of works represents an important opportunity to provide an updated view of innovation in the sector of new pigments and additives for corrosion protection with organic coatings. This overview is considering both the point of view of new materials and of investigation techniques and evaluation, highlighting how nanotechnologies on the one hand, and multifunctionality on the other, are the keywords for a future where coatings for corrosion protection will improve our quality of life while taking care of the environment.

AUTHOR CONTRIBUTIONS

All authors contributed equally to the Editorial.

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