Seminar

Department of Materials Engineering

Thursday, December 11th, 2025, 11:00-12:00

Seminar Room (015) of Building 51 (Marcus Campus)

Corrosion Mechanisms and Mitigation from Sol-Gel Cr_2O_3 to Halide Perovskites

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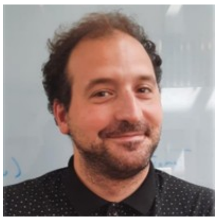
Abstract:

Corrosion remains a major limitation for both structural metals and emerging photovoltaic materials. Chromium oxide (Cr_2O_3) is valued for its stability, strong adhesion, and barrier properties in harsh environments. Although Cr^{3+} based environmentally friendly alternatives to chromates exist, they have not produced continuous and protective Cr_2O_3 layers through a sol gel approach. Here we introduce a sol gel method that forms homogeneous, dense Cr_2O_3 coatings on mild steel and show that the coating interacts significantly with the substrate. Using XPS and ToF SIMS, we characterize the films and examine iron diffusion into the Cr_2O_3 layer, providing insight into interfacial stability. Electrochemical measurements in artificial seawater, with and without bacterial activity, demonstrate that these coatings offer substantial corrosion protection and represent a sustainable and previously unavailable option for replacing chromate based systems.

Corrosion challenges also arise in halide perovskite solar cells, where degradation originates not only from external exposure but from the intrinsic reactivity of the perovskite material itself. Under illumination or heat, the perovskite can generate reactive species capable of attacking metal electrodes such as gold or transforming the perovskite into more aggressive intermediates. These pathways reveal a direct connection between corrosion chemistry and semiconductor behaviour and show why controlling interfacial reactions is essential for long term device stability.

Considering both protective oxide films on metals and reactive interfaces in perovskite devices highlights the broader importance of addressing corrosion at its chemical origin across diverse materials. This integrated perspective is key to enabling durable and sustainable performance in technologies ranging from structural alloys to next generation solar cells.

Bio:



Dr. Davide Raffaele Ceratti is a Junior Professor at the École Nationale Supérieure de Chimie de Paris, within Paris Science et Lettres. Following his doctorate, Dr. Ceratti pursued several international post-doctoral positions. He worked at the Weizmann Institute in Israel on the self-healing properties of halide perovskites, supported by the SAERI fellowship, and later held a Marie Curie Fellowship at the Institut Photovoltaïque d'Île-de-France. Before joining ENSCP, he was a post-doctoral researcher at Sorbonne Université. Today, Dr. Ceratti teaches electrochemistry and materials science and his research explores self-repairing functional materials, ranging from self-healing perovskites for solar energy to sol-gel coatings capable of regenerating after damage for corrosion protection.

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