

SPECIES – SPEciation of Chromium in Ionic liquids as alternative Electrodeposition Solvents

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During the cold rolling of steel, the thickness of the hot-rolled steel strips is reduced by applying a high pressure with two rolling cylinders. These cylinders have to be protected from the harsh conditions. The rolls are coated with a hard chromium layer which is electrodeposited from an aqueous solution containing the toxic, mutagenic and carcinogenic Cr(VI) besides other harmful compounds such as sulfuric acid. Powered by the quest to a sustainable production process and by the incentive of new European legislations, OCAS NV (research center affiliated with ArcelorMittal Ghent and the Flemish Government) has already been working for 6 years on a patented Cr(VI)-free alternative on which they have the world exclusive licence. This new hard chrome-plating process is established by the electrodeposition from a Cr(III) containing ionic liquid (IL) on a steel substrate. Advantages include the presence of the more sustainable Cr(III) as alternative for Cr(VI), the lack of sulfuric acid and hydrogen embrittlement, the broader potential window of the ionic liquid with regard to water, and the intrinsically more efficient reduction process of Cr(III) to Cr(0).

However, despite the fact that already reasonably good layers could be established, even on semi-industrial pilot line scale, there exists still a considerable lack in fundamental knowledge, which will help to optimize the process.

In this industry-oriented project, the complexation of the Cr(III) in the ionic liquid is already analyzed by means of several spectroscopic techniques such as single crystal XRD, UV-Vis, FTIR, and Raman Spectroscopy. In the future, Extended X-Ray Absorption Fine Structure (EXAFS) measurements will be performed on synchrotron facilities. The first challenge is to study the different complexes present and their relative equilibria by means of the spectroscopic data of the pure compounds, in combination with statistical data treatment. It is expected that this information can be coupled to the electrodeposition process and IL behavior and will allow to master the process in this alternative medium.