Electrodeposition of aluminium/ceramic metal matrix composite coatings from ionic liquid

S.Caporali[1,2] and S. M. Martinuzzi[1]

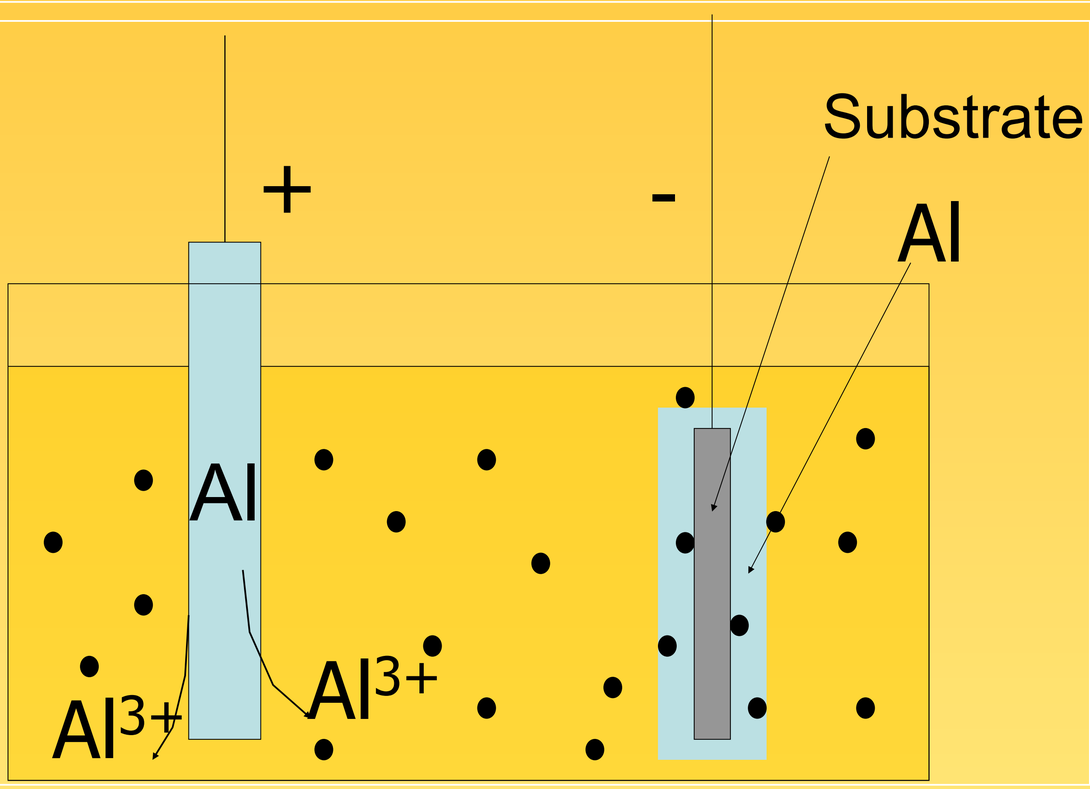
1) Consorzio INSTM, Firenze, Italy
2) CNR, Istituto dei Sistemi Complessi, Sesto Fiorentino, Italy

Introduction:

Metal Matrix Composites (MMCs) have evoked a keen interest in recent years for the very large number of potential application ranging from aerospace to energy production. In particular, the interest on these materials is related to their superior strength-to-weight ratio and high temperature, corrosion and tribocorrosion resistance. Electrodeposition is the more commonly used technique to obtain MMC coatings and its application can be traced back to 1928 when copper/graphite composite was realized for self-lubricating surface for automotive purpose [1]. Alternative metal matrix have been proposed and, on the ground of its low weight, high corrosion resistance, abundance and low toxicity, aluminium resulted among the most promising metal matrix [3,4]. However, aluminium-based MMCs are much more complex to be produced since aluminium can not be electrodeposited from aqueous media. Ionic Liquids (ILs) can be used to overcome this issue.
In this contribution preliminary results of a running study aiming to the production of aluminium matrix MMC composite coatings are presented.

Principle of the method:

Electrodeposition of aluminium from chloroaluminated ILs. Ceramic particles are dispersed into the electrolìplating bath. The particles are embedded into the growing metallic layer.



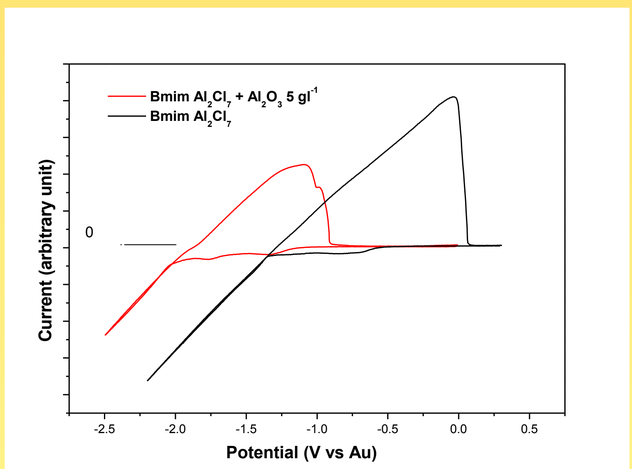
Analytical techniques:

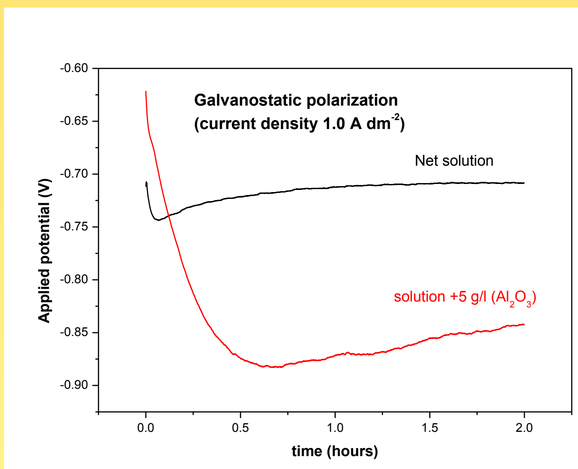
Electrochemical
- ✓ Cyclic Voltammetry
- ✓ Potential–time curves

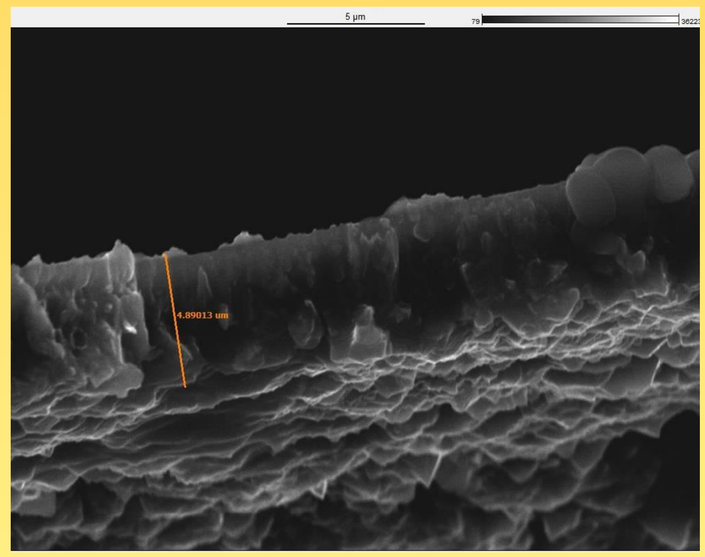
Physical
- ✓ Scanning electron microscopy (SEM)
- ✓ Energy dispersive X-ray (EDS)

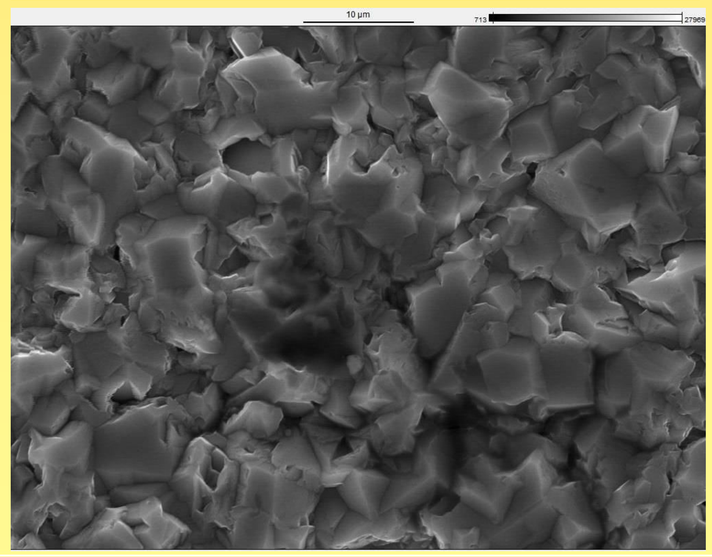
Al_2O_3

The presence of solid particles increases the overpotential required for the reduction of aluminum.

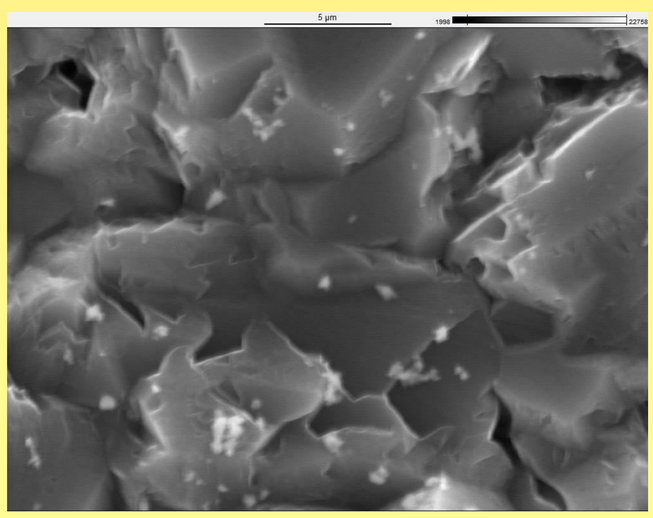


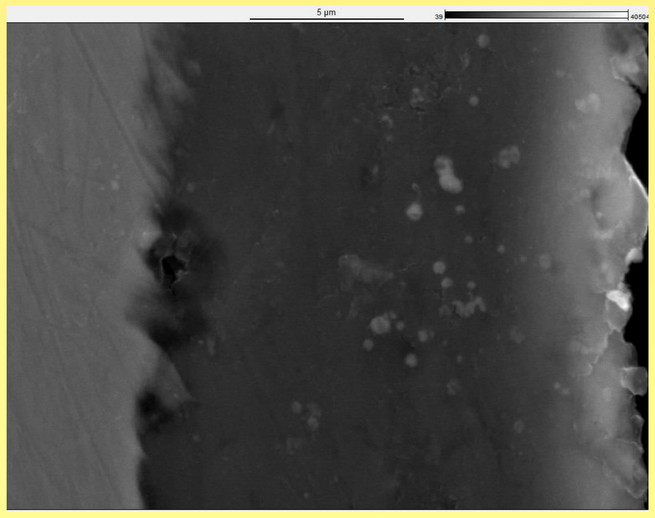






ZrO_2





Above: SEM images of the Al/Al_2O_3 composite coatings
Left: SEM images and cross section of the Al/ZrO_2 composite coating.

Conclusions:

- Composite coatings constituted by ceramic particles embedded in metallic aluminium matrix were obtained via electrodeposition from a chloroaluminate ionic liquid.
- The deposition parameters should be optimized in order to achieve more dense and homogeneous coatings.

Acknowledgements:

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n°608698.