# Thin-film ceramic coatings based on sol-gel chemistries for corrosion protection of low-grade carbon steels

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Corrosion protection of low-grade steels is a challenging task; however, carbon steels are cheaper than chromium and nickel-based alloys. Therefore, durable coatings capable of protecting carbon steels in order to expand their scope of use are highly desirable.

An approach to develop such protective layers is to pre-condition the surface by heating under oxygen-poor atmospheres, in order to develop a passive layer of magnetite. On this surface, a film is applied to enhance its passivation, followed by heating for sintering this coating. Thin films based on ceramic materials, such silica or zirconia, hold promise as candidate coatings as they are passive, and can be made in water-based suspensions. The thickness of these films, usually in the tens to hundreds of microns, goes well below the tolerance of already machined pieces that might be treated with this type of process.

In this work, commercially available, low-grade carbon steel coupons were first heated (below 500 ºC) and then coated with films made by sol-gel techniques. Upon coating, the samples were sintered under heat.. Corrosion protection was evaluated by immersing the coupons in stagnant 35g/l NaCl solutions by impedance spectroscopy and linear sweep voltammetry. The surfaces, prior to and after coating, were characterized by scanning electron microscopy (SEM), energy-dispersive spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS). Overall, the results of this study stressed the relevance of heating conditions prior to coating, in order to obtain a surface capable of resisting the application of a slightly acidic (or basic) coating which, after sintering, can significantly increase the corrosion resistance and shift the pitting potential. The nature of these protective features was related to the structural changes observed at the metal surface upon heating, and the consequences of such surface modifications in the shape and quality of the attached film.