PLASMA TREATMENT OF METALLIC ARTEFACTS

Michal Prochazka, Vera Sazavska, Radek Prikryl, Radka Balastikova, Petra Fojíková, Frantisek Krcma
Faculty of Chemistry, Brno University of Technology
Purkynova 118, 612 00 Brno, Czech Republic

The traditional process of preservation of artefacts is a long term procedure. Ageing destroys untreated artefacts and we lose our cultural heritage. This study focuses on alternative way how to save the artefacts before their destruction.

Plasmachemical treatment appears to be an effective and fast way of restoration and preservation of archaeological metallic (iron, copper, bronze and brass) artefacts. The whole process consists of two steps: corrosion removal and deposition of a protecting film.

First, the incrustation and corrosion layers are removed by partial reduction using hydrogen glow discharge plasma. In comparison with the conventional restoration techniques, this method offers significant advantages regarding the quality of the object surface and time savings. Finer surface details can be preserved. The corrosion removal process is very complex. The influence of both hydrogen atom reduction and heavy particles sputtering was investigated.

It is necessary to deal with archaeological items carefully in order not to change their properties. The effect of heating as well as the time dependence of corrosion removal and the effectiveness of the plasma process were explored. Operation at pulsed mode was also performed. In-situ measurements monitoring the rate of corrosion removal were done via optical emission spectroscopy. Treated samples were analyzed by SEM in order to determine their surface elemental composition and surface morphology.

Once the surface of the artefact is cleaned, it is highly active and oxidizes easily. To prevent the oxidation, thin film deposition of parylene or SiO₂ layer is performed.

Parylene (poly-para-xylene) coatings are chemically inert, conformal and transparent with excellent barrier properties but relatively small adhesion. Parylene coatings were prepared by standard chemical vapor deposition (CVD). SiO₂-like high density films have very good barrier properties and excellent adhesion. Plasma enhanced chemical vapor deposition (PECVD) enables preparation of SiO₂ based thin films with higher flexibility due to incorporated organics groups.

The coatings were characterized by various methods in order to obtain information about their thickness (ellipsometry), chemical structure (FTIR) and elemental composition (XPS), surface morphology (SEM) and barrier properties (OTR).

*This work has been supported by the Ministry of Culture of the Czech Republic, project No. DF11P01OVV004.