

Efficient Electrochemical Processes for the Electroplating Industry using DiaChem® Electrodes

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Diamond coated titanium and niobium electrodes provide unique advantages for industrial electrochemical processes. The most important properties are the outstanding chemical inertness, the widest known electrochemical window before water decomposition takes place and the use as anode as well as cathode. The overpotential for oxygen evolution in water containing electrolytes is in the region of 2.7 to 2.9 volts, which is much higher than conventional electrode materials for example lead or mixed metal oxide (MMO) electrodes. These advantages offer the possibility to use diamond electrodes efficiently for several processes in the electroplating industry.

Fraunhofer IST and METAKEM GmbH have produced DiaChem® electrodes with different geometries and dimensions using large-area hot-filament CVD (Figure 1a and b). Typical growth rates are between $0.5\mu\text{m/h}$ and $1.0\mu\text{m/h}$. Doping levels of a few thousand ppm boron yield electrical resistivities lower than $50\text{m}\Omega\text{cm}$.

DiaChem® electrodes have been loaded with increasing current densities up to several A/cm^2 in sulfuric acid over months. No degradation of the electrode surface nor the electrochemical performance could be detected, thus demonstrating the extreme chemical stability of these new electrodes.

DiaChem® electrodes have been tested in the production environment of electroplating industry. Examples of these applications are:

- oxidation anode in combination with MMO electrodes as working electrodes in a “lead free” chromium electroplating process;
- oxidation of Cr^{III} to Cr^{VI} in chromic sulfuric acid for etching ABS plastics;
- decomposition of organic or cyanide additives in electroplating baths;
- stable anode in fluoride containing electrochemical etching or electroplating

In all these applications DiaChem® electrodes yield a high efficiency as shown in Figure 2. We will discuss our investigations in terms of energy, costs and ecological efficiency.

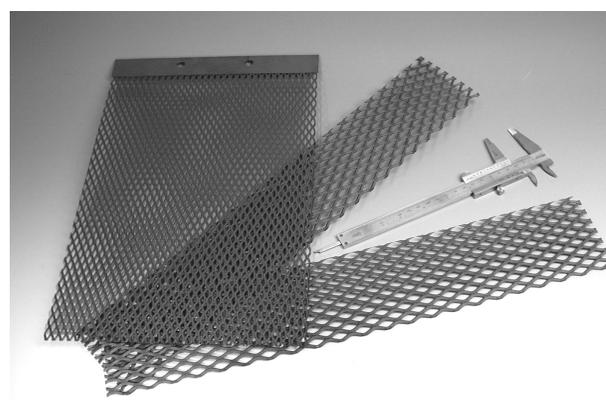
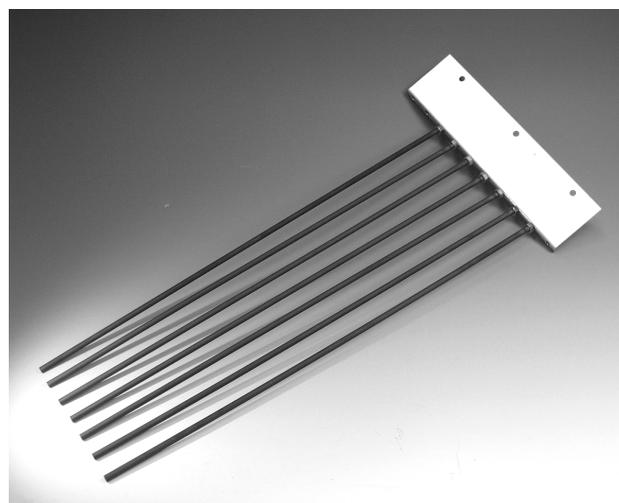


Figure 1a and b: DiaChem® electrodes for electrochemical processes in electroplating industry

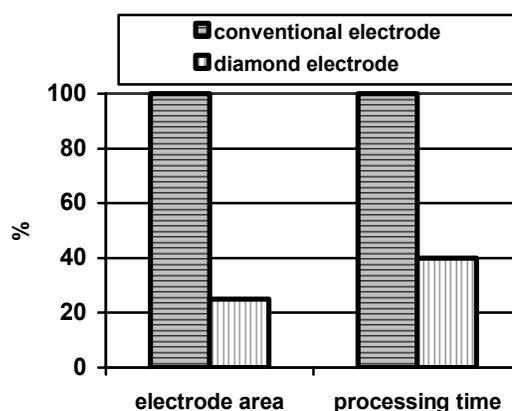


Figure 2: Increase of electrode efficiency by reduction of electrode area by applying DiaChem® electrodes for the oxidation of Cr^{III} to Cr^{VI} in chromic sulfuric acid for etching ABS plastics