

# **Phenomenon of Electrochemical Deposition of Metals via a Supercooled Metal Liquid and Its Utilization for Applying Electrocoatings Having Enhanced Properties**

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An earlier unknown phenomenon of electrochemical deposition of metals via a supercooled metal liquid has been found using new in situ methods. The phenomenon resides in the fact that while a metal is electrodeposited on a solid cathode in an aqueous solution, a supercooled metal liquid is being formed and solidified at the deposition temperature, producing a crystalline or amorphous structure. It is caused by an extremely rapid (explosive) character of metal precipitation due to a chain reaction of electrochemical formation of atoms and a transition of the atom associates from a liquid state to a more stable solid state. The phenomenon is confirmed by the existence in the electrodeposited metals of metastable structures corresponding to: an amorphous structure of the solidified metal liquid, highly defective crystalline structure of the metal quenched from its liquid state, and intermediate crystalline modifications arising during the superfast cooling of the liquid phase of the polymorphous metal. It is proved by the availability of metallic links at the electrodeposited metal/cathode interface, and by the formation of primary solid solutions and intermediate phases resulting from the electrodeposition of metals alloyed by metals and non-metals. This phenomenon manifests itself in the predictable changes of the macrostructure, microstructure, substructure, structural condition, crystallographic texture, surface morphology, structural inhomogeneity and defects of the crystalline structure of metals with an increase in the supercooling rate while they are being electrodeposited. Through acting on the metal liquid by certain agents during electrodeposition, one can modify structure and hence properties of electrocoatings. Utilization of the phenomenon to develop of processes for making electrocoatings with enhanced properties is addressed.