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Electroless plating interests scientists and engineers

Electroless plating (also known as autocatalytic deposition) is a process of depositing a particular metal on a substrate, which may be metallic or non-conducting like plastics or ceramics. Deposition is achieved by reducing the metal ion to metal at the material/solution interface by a chemical reducing agent.

A casual observation, by Riddell and Brenner, that addition of sodium hypophosphite to a nickel alloy plating solution caused deposition of more metal than what is expected by Faraday's laws initiated the idea that metal can be deposited by chemical reduction. This led to the formulation of electroless nickel plating bath and thus ushered in the era of electroless plating.

Silvering glass is essentially electroless deposition of silver. Even though this process is much older than electroless nickel deposition, it is not considered as the beginning of electroless deposition. This is because silvering remained as an art in the hands of technicians and was not investigated from a scientific viewpoint. On the contrary, electroless nickel plating was investigated scientifically. Knowledge of basic principles of 'chemical plating' thus gained was applied to the deposition of several metals and even alloys. A new area of science and technology was thus created.

Viswanathan (**page 537**) discusses the science and technological applications of electroless plating. After a brief historic introduction, the discussion starts with scientific principles governing the pre-treatment step (called sensitization and activation), which makes the substrate surface receptive to depositing metal atoms and improves its adhesion to the substrate.

Chemistry of electroless deposition is discussed by taking the example of electroless copper deposition. It is shown that the theory of two conjugate reactions (oxidation of reducing agent and reduction of metal ion) occurring at the mixed potential is an oversimplification (of the mechanism of electroless plating) and the actual mechanism is more complex. Besides the mechanism, the structure of electroless deposit is also of interest to scientists.

Notwithstanding the fact that electroless deposition has scientific challenges even today, the author shows that it has many proven technological applications such as in printed circuit boards, fabrication of semiconductor devices, forming microwave integrated circuits, thin-film magnetic devices, electromagnetic interference shielding, etc.

Marine geophysical exploration

K. S. R. Murthy (**page 532**) discusses the utility of marine geophysical studies in investigating several aspects of oceanography such as the seabed morphology, stratigraphy, structure and tectonics of the continental margins and oceanic basins. Data and results are presented from the eastern continental margins of India (ECMI), Bengal Fan and the Central Indian Ocean Basin (CIOB).

Models derived from magnetic anomalies of the nearshore regions of the Visakhapatnam and Bhimunipatnam shelf of Andhra coast revealed a close relationship between structural lineaments, onshore drainage channels and placer concentrations. High-resolution seismic reflection data located palaeo channels beneath the innershelf (30 m water depth) that might have been active during the lowered sea levels of the Late Pleistocene period (18,000 yr BP).

Seismic reflection data have also identified the morphological features related to the eustatic sea level fluctuations. A relict shore line parallel to the coast at about 130 m water depth was located all along the eastern margin that corresponds to the major sea level regression during the Late Pleistocene glaciation. Minor strandlines related to the Holocene transgression were also identified at 30, 60 and 90 m water depth from seismic data of Visakhapatnam to Gopalpur shelf. Some of the significant morphological features recorded from the offshore river basins include gas seepages and zones of gas-mixed sediments. Such gas seepages are found to be extensive over the Krishna–Godavari offshore basin and might be considered as good indicators of the hydrocarbon potential of these areas.

Models derived from magnetic, gravity and bathymetry data of ECMI and Bengal Fan helped not only in locating the major structural lineaments of ECMI and Bengal Fan but also in inferring some evolutionary stages of this passive margin formed due to breakup of India from Antarctica in Late Jurassic (140 Ma). Some of the major structural lineaments identified from the data and the derived models include (i) the Ocean–Continent boundary off ECMI, (ii) linear trends of major aseismic ridges that were the traces of the hotspots over which the Indian Plate moved during its northward flight, (iii) rift-related dykes beneath the inner continental shelf, and (iv) block tectonics within the continental basement off Visakhapatnam to Paradip. All these tectonic lineaments are related to the evolution of this passive margin and model studies revealed that some of them extend to the onshore region and therefore need further study.

The collision of Indian and Asian Plates took place at about Eocene time (54 Ma) and the continued northward drift of Indian Plate is the major contributing factor for the instability of the Indian shield, resulting in major earthquakes in the extra-peninsular and in recent times even in the Deccan shield areas. A peculiar phenomenon is observed in the equatorial region of the Central Indian Ocean Basin (CIOB), south of Sri Lanka, that is also a direct consequence of the Plate collision. The Oceanic Crust in this region is currently under compressional stress, resulting in buckling or deformation of the crust. Geophysical studies were carried out over this region of intraplate deformation under an Indo-Soviet International Long-Term Collaboration Programme during 1988–92. Seismic reflection data over this area revealed some new information about the stratigraphy, structure and style of the deformed blocks in the equatorial region of CIOB.