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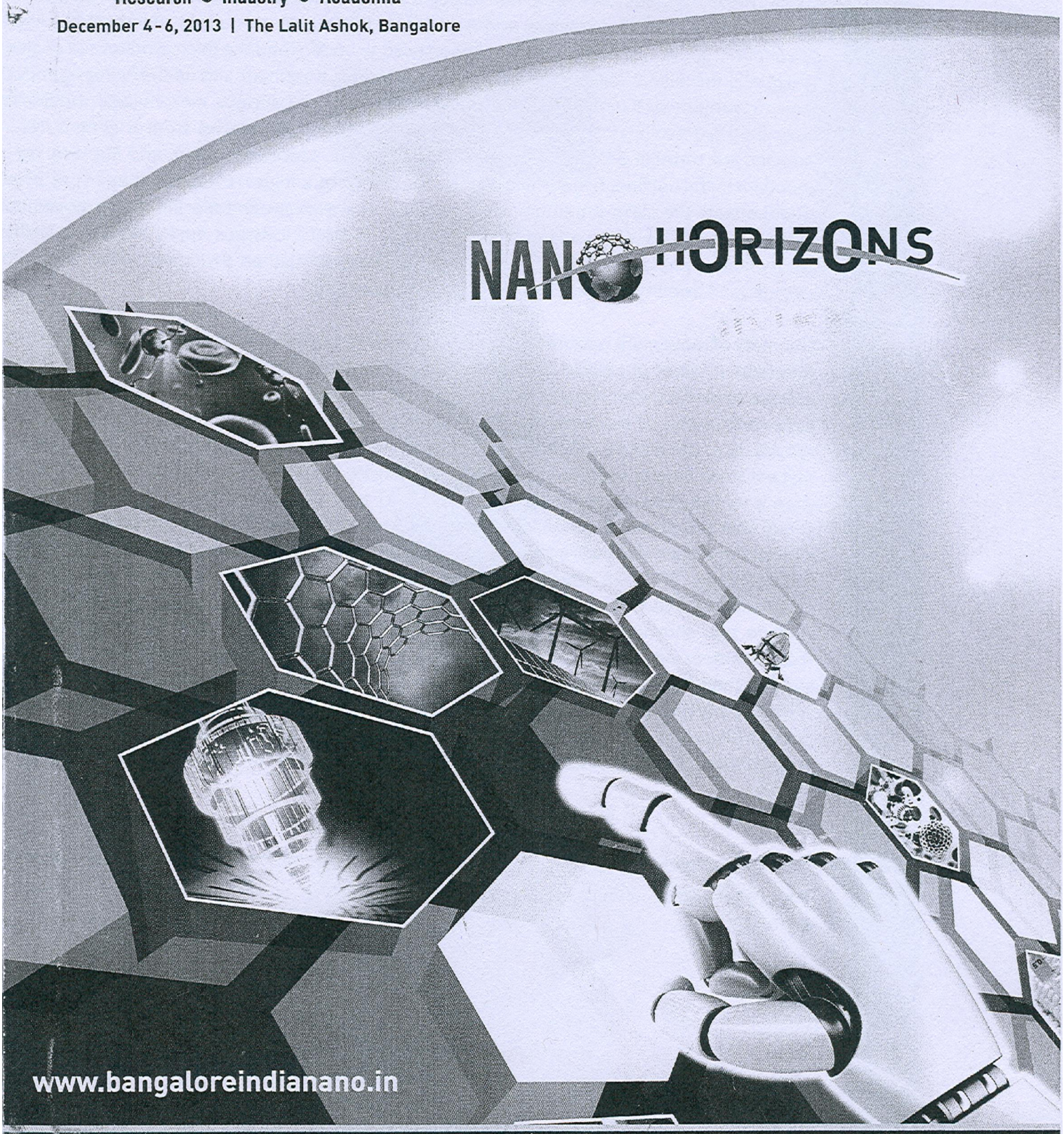

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Nano Characterisation of Wastewater Euglenoides through Scanning Elcectron Microscope (SEM)

SEM is being increasingly used in various branches of material science, but its use by the biologists for nano-chracterisation and examining delicate cells and their surrounding hydrated polymer matrices is rare. These methods have yet to find its applicability in phycological advancement studies vis. algal biofuel, efficient nutrient removal and wastewater treatment, production of industrially important metabolites etc. In this context SEM has been used to understand the microstructure of euglenoides (enigmatic unicellular algae in relevance to wastewater treatment and lipid/biodiesel production), their movement patterns, nutritional modes and their cell surface morphology, topologies and associated extracellular polymeric substances. More than 20 species from 6 genera have been chracterised through SEM from domestic wastewaters. *Lepocinclis ovum* and *Euglena* spp. were abundant in the nutrient rich surface waters. The cell morphologies revealed S-shaped proteinaceous strips beneath the plasma membrane of the cells that are unique and specific, aiding movement. The pellicle strips/striae were oriented longitudinally in bacteriovorous euglenoides and helically in eukaryovores, photautotrophs and osmotrophs. These specialized structures called striae provides articulation flexibility for metaboly/cytoplasmic movement.

The study of movement patterns indicated metaboly in euglenoides as *Euglena* spp. being correlated with large number of pellicle strips (over 20) and facilitates ingestion of large food particles. More delicate striae (200 nm) showed higher degrees of metaboly, however robust striae (>250 nm) were more constrained for movements. Phagotrophs and primary osmotrophs lack striae projections. The topologies of the pellicle and the striae patterns indicated i) small rigid cells (<12 longitudinal striae) that eat small prey as bacteria (bacteriovores); ii) large cells (20-60 helically arranged striae) that eat large prey like eukaryotes (eukaryovores) and iii) cells of different sizes (18-80 helicaly arranged striae) that are photoautotrophs and secondarily osmotrophic. The nutrient analysis showed that most of the euglenoides were associated with high nutrient conditions i.e. (TOC: 20-180 mg/; TN:16-80 mg/l and TP: 8-28 mg/l). Based on nutrients, physico-chemical environment and SEM morphologies, a cluster analysis elucidated two broad clusters a)comprising of mostly *Lepocinclis* and *Euglena* spp. showing high nutrient and low redox tolerant species and b)comprising of *Phacus*, *Trachelomonas* and *Cryptoglena* sp. showing moderate to low nutrient tolerance. The SEM-EDXA analysis showed cell secretions (mucilage) and cell constituents have higher Ca and Oxygen content and relatively high Phosphorus in cells. Investigations of characteristic nano-features of euglenoides through electron microscopy would help in screening beneficial algae and achieving biotechnological breakthroughs for various applications and create new avenues for sustainable development.

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