

## **N-Isopropylacry Amide Nanogel for Surface Treatment of Corroded Copper Ornaments associated on Coptic Linen**

This paper presents the role of nano structured composites of N-Isopropylacry Amide Nano-gel as a carrier for increasing the performance of surface cleaning of corroded copper ornaments embroidered to linen artifacts. A novel approach to chemical cleaning by neutral soap, loaded on nano gel carrier, was applied for removing tarnishing of copper ornaments, associated to linen fabric. The accelerated aging was performed on Copper/linen coupons, which were accelerated thermally in humidified and acidic condition. Green patina was formed on the coupons, and the physical and chemical properties of both linen and copper were affected. Visual examination, light microscope, SEM-EDS and FTIR-ATR analysis, and color measurements were used to study the behavior of copper corrosion and undyed linen fabric through accelerated aging tests. Evaluation of the proficiency of the selected material in cleaning and its side effects was discussed. The results demonstrated the significant performance of nanogel in cleaning copper coupons without alteration of its morphological appearance and chemical structure. Stereo photos of treated specimens approved the removal of the green patina layers. Progress achieved by removing the tarnishing, active corroded area was noticed significantly through SEM photos. The experimented nanogel was used for cleaning copper ornaments of Coptic linen which is among the collection of archaeological textiles in the Hurghada museum dated to 18 - 19<sup>th</sup> centuries.