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Modification of Surfaces with Carboxymethylthio Ligands Towards Chelate-Assisted Extraction of Copper

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Copper (Cu) is an essential metal in biological systems; however, at concentrations beyond threshold limits, not only can it kill aquatic organisms but also it can become highly toxic to humans. Copper can bind onto certain organic ligands via coordination mechanisms. Electrochemical grafting of aryl diazonium derivatives have successfully been used to modify substrates by introducing layers of various organic functional groups onto metallic and semiconducting substrate surfaces.1 Strategies involving functionalization of substrates with large-molecular-weight oligomers and peptides via diazonium grafting routes for extraction of heavy metal ion (HMI) pollutants have been reported. Some of these methods involve introduction of chelating groups in more than a single step. However, a simpler one-step quick grafting of low-molecular-weight HMI - chelating agents may not only present some cost reduction advantages towards devising kits for HMI extraction but also permit the fabrication of relatively thinner layers with optimal surface grafting with excellent chelation efficiency. Silicon is one of the most abundant materials on the earth's crust and its suitable surface chemistry has motivated organic functionalization efforts towards developing a wide range of applications. The purpose of this study is to explore a one-step functionalization strategy for introducing carboxymethylthio (CMT) chelating groups via direct electrografting of the diazonium cation 4-[(carboxymethyl)thio]benzenediazonium cation, (4-CMTBD), onto Si surface, leading to fabrication of the Si-(4-CMTB) surface. The investigation of Cu chelation is also studied.

Finding: The fabricated surface, Si-(4-CMTB), is capable of chelating Cu ions from aqueous solutions at trace amounts as shown by Raman spectroscopy.2

Conclusion & Significance: The surfaces may be of potential engineering interests for HMI sensing and/or extraction. This study offers positive contributions in the fields of environmental protection, forensic diagnostics, biosensing, and mineral prospecting among other related disciplines.

Biography

John Onyango Adongo is a doctoral candidate registered at Humboldt-Universität zu Berlin, Germany. He conducts collaborative research within the surface sciences group of Dr. Jörg Rappich based at the Institut für Si-Photovoltaik, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH. He currently holds a tutorial fellow position at the chemistry department, Egerton University, Kenya. As a material scientist, his doctoral research focusses on the design, fabrication and testing of potentially renewable HMI – chelating surfaces incorporating silicon as the substrate material. The approach for functionalizing substrate surfaces majorly involves the facile electrografting method achieved via electroreduction of aryl diazonium salts.

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