Fabrication of highly ordered and oriented self-assembled monolayers of aromatic selenols on Au(111): comprehensive characterization

[1]W. Azzam, [2]N. A. F. Al-Rawashdeh, [3]Najd Al-Refaie, [4]O. Shekhah and [5]A. Bashir

[1] *Tafila Technical University, Jordan*
[2] *Higher Colleges of Technology, RAK-UAE & Jordan University of Science & Technology, Jordan*
[3] *Umm Al-Qura University, Saudi Arabia*
[4] *King Abdullah University of Science and Technology, Saudi Arabia*
[5]*Max-Planck-Institut für Eisenforschung-Düsseldorf, Germany*

Abstract (not more than 300 words)

Self-assembled monolayers (SAMs) formed by adsorption of 1,2-dibenzyldiselenide (DPMSe) and 1,2-diphenyldiselenide (DBSe) on Au(111)substrates at room temperature have been characterized using scanning tunneling microscopy, X-ray photoelectron spectroscopy, infrared reflection absorption spectroscopy, near-edge X ray absorption fine structure spectroscopy , and lowenergy electron diffraction. Upon adsorption, the Se−Se bonds in DPMSe and DBSe were cleaved on the gold surface to form phenylmethaneselenolate (PMSe) and benzeneselenolate (BSe) species, respectively. Although both PMSe and BSe molecular entities only differ in their structure (an additional methyl group in PMSe), the resulting monolayer films revealed noteworthy dissimilarities regarding their adlayer SAM structure and surface morphology. The molecular adlayer structure and orientation of PMSe and BSe species were found to vary significantly with the immersion time (IT). The resulting PMSe films were poorly organized, and the structure was described by a ($4\sqrt{3} \times 2$) rectangular unit cell for the SAMs prepared with 24 h of IT. Moreover, the PMSe-SAMs were found to be unstable upon exposure to air for a long time. Our results showed that exposure to air for 48 h results in the formation of small bright ad-islands, which have a height corresponding to that of a single atomic step on the Au(111). Contrary, BSe-SAMs exhibited densely packed and well-ordered monolayers, and two different structural phases were resolved at short and long ITs. The most densely packed structure was obtained for SAMs prepared with very short ITs (10 min). Upon increasing the IT, the SAMs exhibited structural changes to a lower density of molecular packing structure. The spectroscopic data also confirmed this structural transformation by suggesting an upright orientation for BSe-SAMs prepared after short ITs and strongly inclined adsorption geometry for SAMs prepared after long ITs.

Keywords— *Aromatic Selenols, Au(III), Infrared reflection absorption spectroscopy, Self-Assembled Monolayers.*

Professional Biography (100-150 words)

Prof. Al-Rawashdeh received his Bachelor degree in 1986 and Master degree in 1989 from Yarmouk University-Jordan, and Ph.D. degree from Georgetown University, Washington DC, USA, in 1997. He has been a Faculty member at JUST since 1997 and on leave from 2017-Present at HCT-UAE. He has received an award of the Ministry of Higher Education of

Jordan for the Distinguished Research Paper of 2009, Fulbright scholarship-USA, DFG and DAAD. He has published over 50 refereed journal and conference papers, two book chapters, presented his work in over 30 international conferences. His current research interests are in the areas Material Sciences.



Email Id: nalrawashdeh@hct.ac.ae; nathir@just.edu.jo