in situ Spectroelectrochemistry of Nanostructured Fullerene Films

Lothar Dunsch,[1] Matthias Krause,[1] Uwe Kirbach,[1]
Pavel Janda[2] and Ladislav Kavan[2]

[1] IFW Dresden
Helmholtzstr. 20
Dresden D-01069
Germany

[2] J. Heyrovsky Institute of Physical Chemistry
Dolejskova 8
Prague CZ-18223
Czech Republic

It has been shown earlier that C60 can be nanostructured electrochemically to form ordered clusters at surfaces[1]. These nanostructures have a considerable potential due to their electronic properties as materials for microelectronic devices. We have demonstrated that the charge transfer into highly ordered C60 films on HOPG leads to a distinct increase of the lateral lattice constant from 1 nm to approximately 6 nm. The resulting films are very stable in solution as well as under ambient conditions. Even the deposition of metals does not change the structure. Thus this approach represents a less sophisticated and low cost alternative compared to lithographic methods for nanostructuring.

Structural properties of highly ordered C60 films before and after charge injection were analysed by spectroscopic and scanning microprobe techniques in both aqueous solution and ionic liquids. Formation process and stability of the nanostructure were studied by Raman and IR spectroelectrochemistry. The injection of charge significantly changed the microscopic structure of the initial film. Lifting of selection rules, line shifts and splittings as well as new lines have been found. In the Ag (2) mode region which is characteristic for charge state and cage substitution the line of pristine C60 disappeared and a split spectral feature with frequencies of 1458 and 1464 cm-1 was observed in the Raman and the infrared spectrum as well. The characteristic lines of new intercage bonds are consistent with the formation of C60 clusters, which would in fact represent a new fullerene based material.

[1] P. Janda, T. Krieg, L. Dunsch, Adv. Mater. 10, 1434 (1998)