SILICON-MOLECULES-METAL JUNCTIONS BY NANOTRANSFER PRINTING : CHEMICAL SYNTHESIS AND ELECTRICAL PROPERTIES

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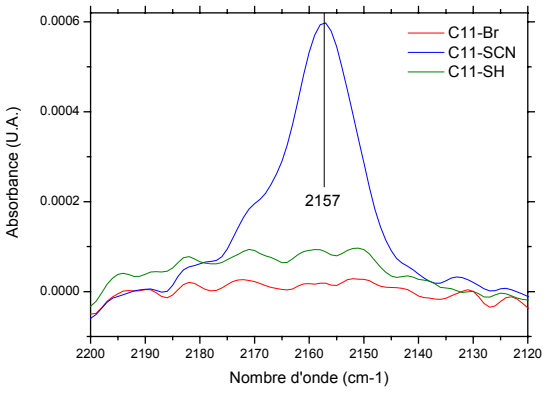
Self-assembled monolayer (SAM) is a powerful technique for the preparation of molecular devices.[1] The upper electrodes of the device are commonly deposited on the SAM by vacuum evaporation of a metal through a mask. This technique often causes short-cicuits in the structure. In order to reduce this diffusion phenomenon, we used a method called nanotransfer printing (nTP).[2] Gold electrodes were deposited by evaporation onto a perfluorated silicone stamp then transfered by contact on a thiol-functionalized SAM.

Here, we describe a route for the thiolation of alkylsilane SAM grafted on silicon. A SAM was prepared by grafting 11-bromoundecyltrichlorosilane on a silicon substrat covered by its native oxide. The bromo-terminated SAM was thiolated by a two-steps chemical surface treatment involving a nucleophilic substitution by potassium thiocyanate in the presence of sodium iodide followed by a reduction with lithium aluminium hydride. The chemical steps were characterized successfully by contact angle, ellipsometry, FT-IR and XPS. In particular FT-IR spectra clearly indicates the presence of –SCN group at 2157 cm^{-1}. XPS mesurements confirms the formation of -SH groups after the chemical reduction. Indeed, the peak area of sulphur remains unchanged while bromine and nitrogen signals disappear.



Till now, we successfully applied the nTP method on saturated alkyl chains (called σ chains). Electric mesurements realized on $Si(p^+)/SiO_2/\sigma$-SH/Au device showed effectiveness of nTP compared to classical evaporation technique. ***Current and capacitance measurements (vs. frequency and temperature) showed noticeable differences in the electronic properties of the two kinds of molecular junctions***. We plan to apply the nTP methode to alkyl chain terminated with aromatic moieties (σ-π molecules).

References

[1] S. Lenfant, C. Krzeminski, C. Delerue, G. Allan, and D. Vuillaume, Nano Lett. **3,** 741-746 (2003).
[2] Y.-L. Loo, D. V. Lang, J. A. Rogers, and J. W. P. Hsu, Nano Lett. **3,** 913-917 (2003).