AFM AND SEM STUDY OF RUBRENE MICRO-CRYSTAL THIN FILM AND NANOWIRES GROWTH

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Regarding organic electronic applications [1,2], rubrene ($C_{42}H_{28}$) has recently attracted attention for the extraordinary large carrier mobility (as high as 15cm^2/Vs[3]) in field effect transistors based on single-crystals. However, so far, no high performance rubrene thin film transistors have been reported. Due to complex molecular conformations[2], the fabrication of high quality rubrene thin film is indeed difficult compared with other oligoacenes.

In this communication, the growth of rubrene on Si/SiO_2 substrates under UHV conditions is presented. At room temperature, the growth of isolated amorphous islands with widths up to 300nm is observed. Temperature dependant Rubrene thin film growth has been investigated. At higher substrate temperature (85^{o}C) and high deposition rate, a mode of growth has been identified which results in micro-crystal rubrene domains with lengths up to 10µm (Fig1). The length of the rubrene domains is sufficient to be covered by source and drain electrode for OFET fabrication. A 80-120nm thick amorphous continuous film with holes covers the whole substrate, on which huge polycrystalline rubrene spherulite structures with widths up to 500mm are observed. From the centre of the islands, rubrene dendrites grow outwards. The nucleation and initial growth of rubrene spherulite structures has also been studied. At the initial growth, the fractal structure has been observed. Afterward, with more deposited material, the compact spherulite structure was formed.

Additionally, rubrene nanowires are observed on these spherulite islands. Studied with Scanning electron microscopy (SEM), the rubrene nanowires have lengths up to 10µm with dimensions of the range between 50nm to 150nm, as shown in Fig 2.

These results open the way for the synthesis of rubrene nanowires and high quality micro-crystal thin films. Besides, the report of thin film growth mode on a “template” amorphous layer indicated new possible strategies to be followed for the realization of rubrene-based thin film OFETs.

References

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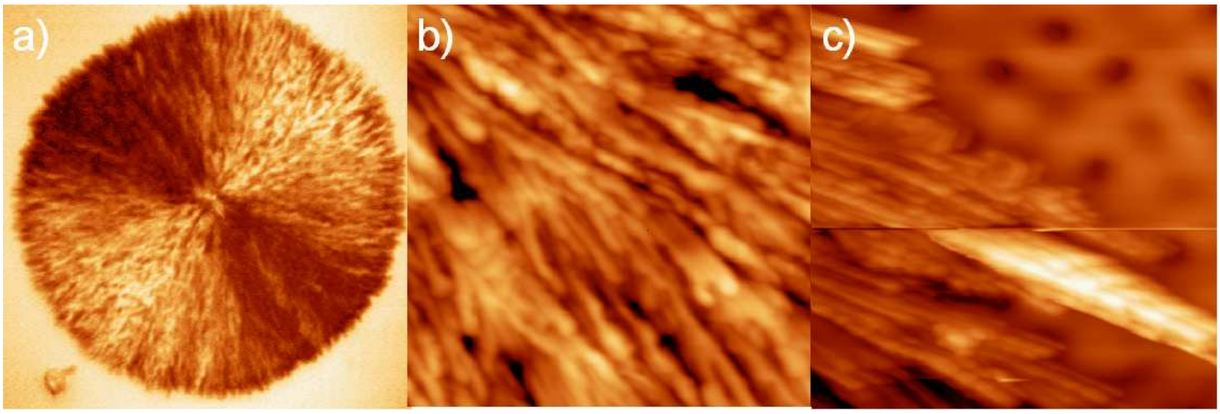

Fig 1. Morphology of rubrene thin films growth on SiO_2. a) optical micrographs of rubrene islands. b) AFM image of rubrene crystalline dendrites (3µm×3µm) c) edge of a polycrystalline island on the amorphous template layer (5µm ×5µm).

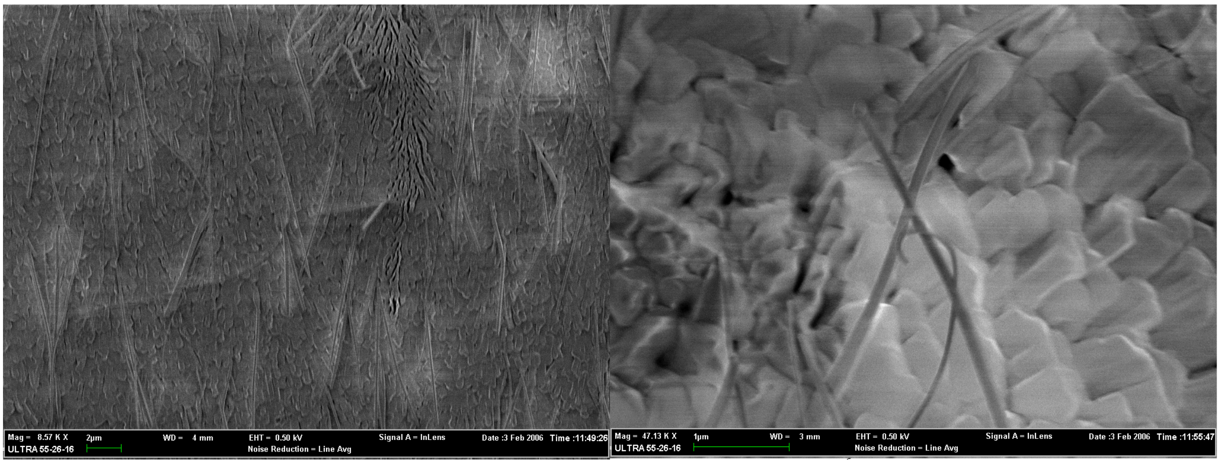

Fig 2. SEM images of rubrene nanowires grown on rubrene thin films.