Supporting information

Ultra-long ordered nanowires from the concerted self-assembly of discotic liquid crystal and solvent molecules

Ji Hyun Park, Kyung Ho Kim, Yung Woo Park, Giusy Scalia

1) AFM profiles of the nanostructures formed on substrates by HAT5 dispersed in different solvents.

a) Nanowires of HAT5 formed from toluene solutions

The AFM image and profiles of the film surface, taken in three different positions, shown in Figure S1, clearly show that the film is formed by several wires aligned along a common direction. The surface profiles have different colors to correlate them with the corresponding locations in the AFM image

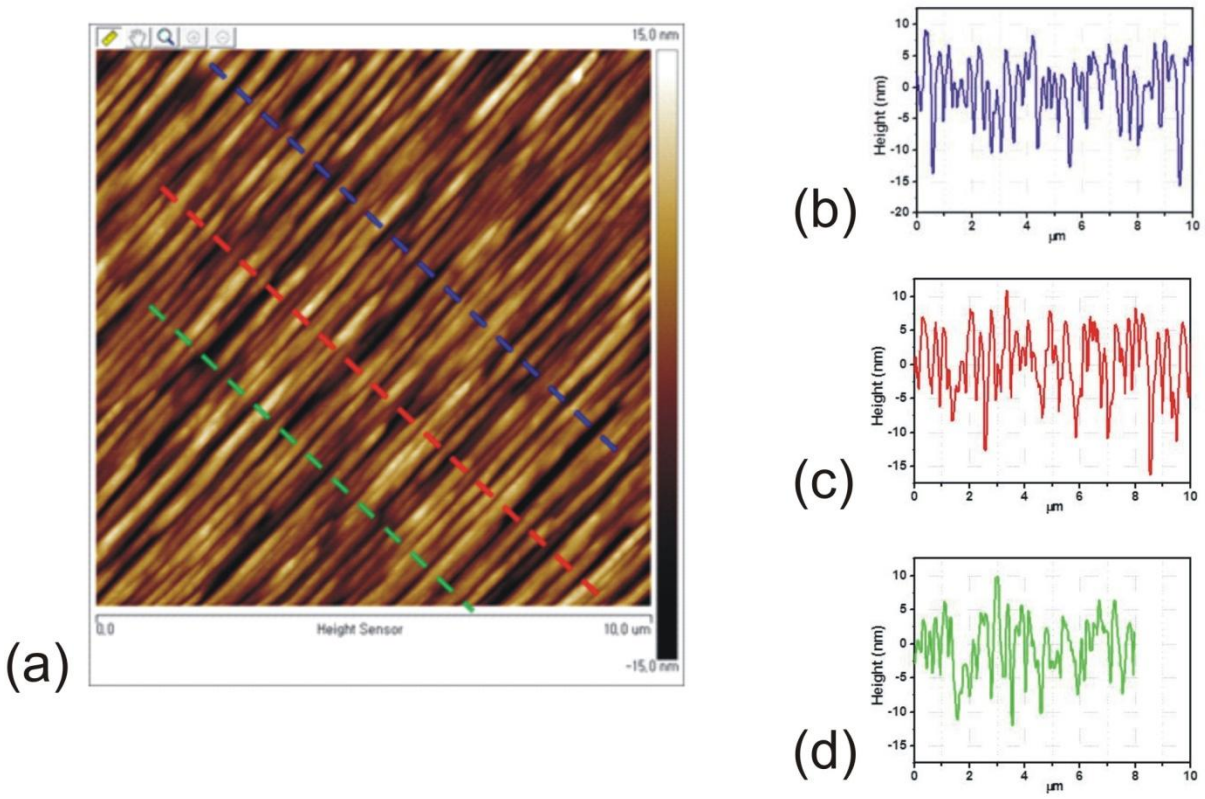

Figure S 1 AFM profiles along directions perpendicular to the axes of the fibers. The values of rms measured along the blue, red and green directions are equal to 4.69 nm, 4.37 nm and 3,93 nm, respectively

b) Nanowires of HAT5 deposited from benzene solutions

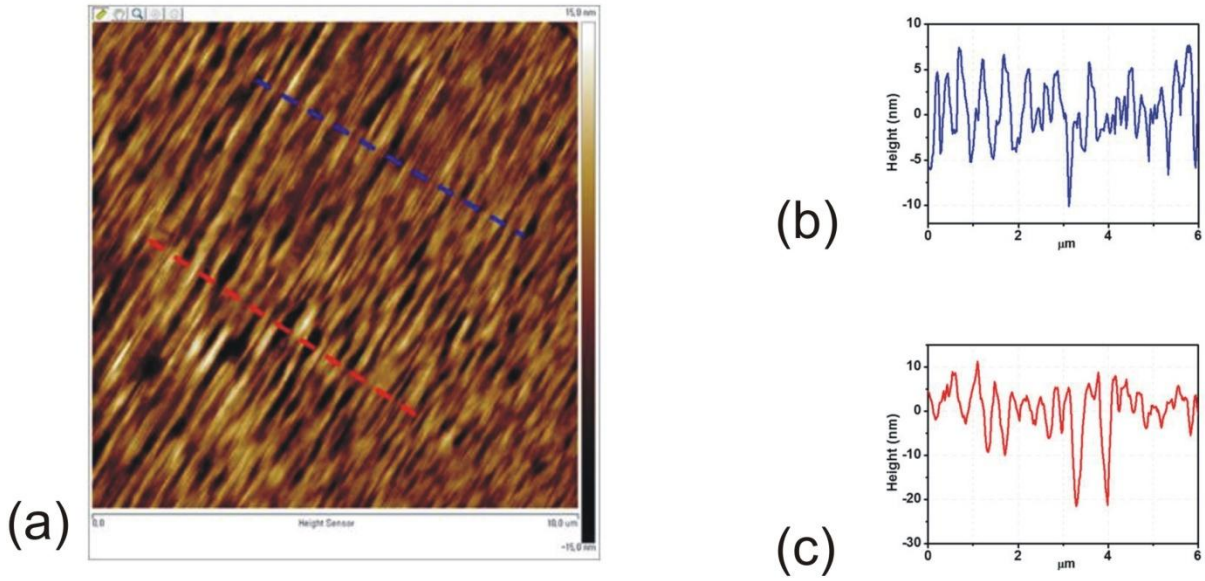

Figure S 2 AFM profiles along directions perpendicular to the fibers. The rms values measured along the blue and red directions are equal to 3.46 nm and 6.02 nm, respectively.

c) Nanostructures of HAT5 deposited from choloroform solutions

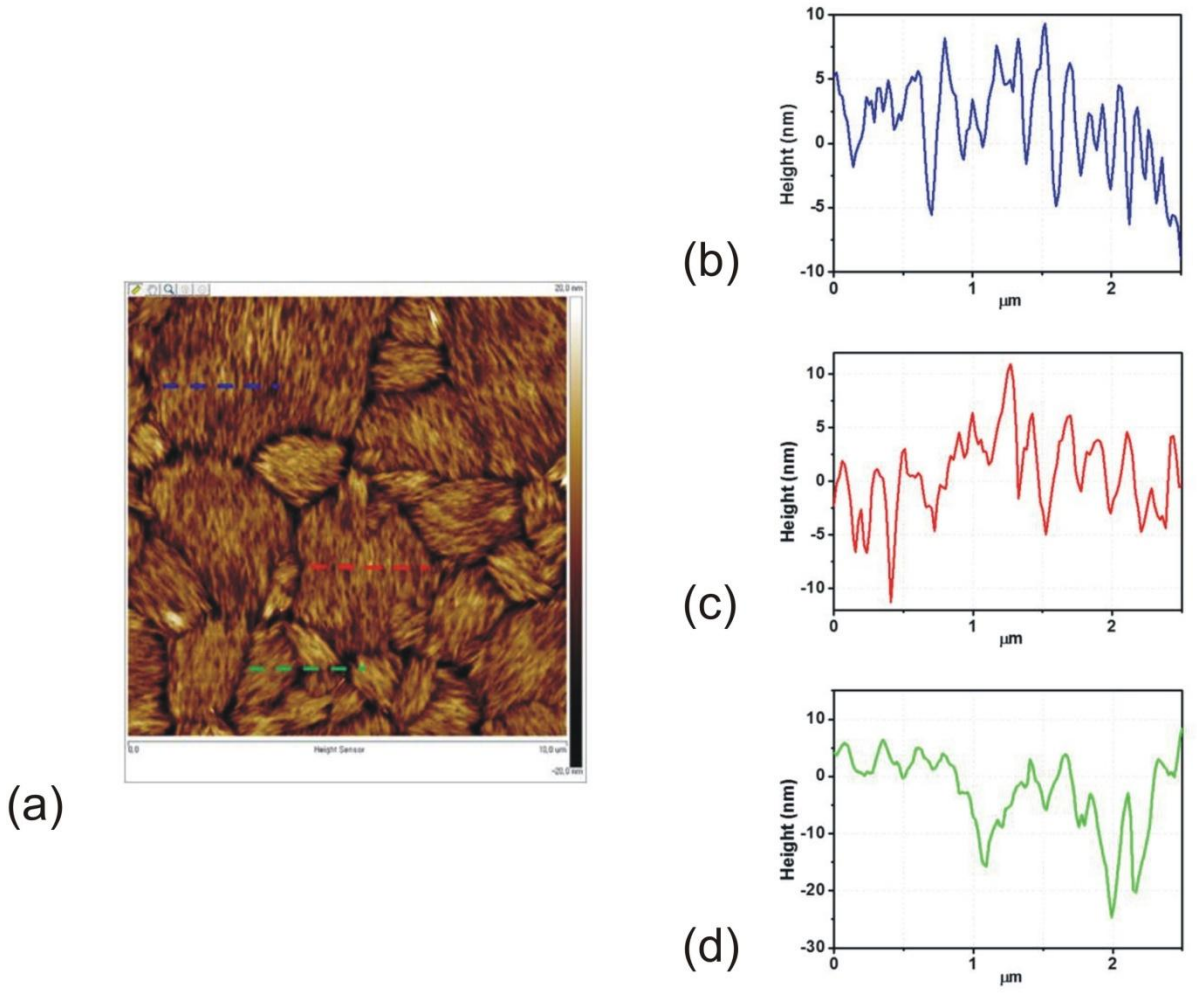

Figure S 3 AFM profiles taken in different domains. The rms values of the structures measured along the directions indicated with blue, red and green dotted lines are 3.43 nm, 3.60 nm and 6.70nm, respectively.

d) AFM Profile of HAT5 deposited from heptane solutions

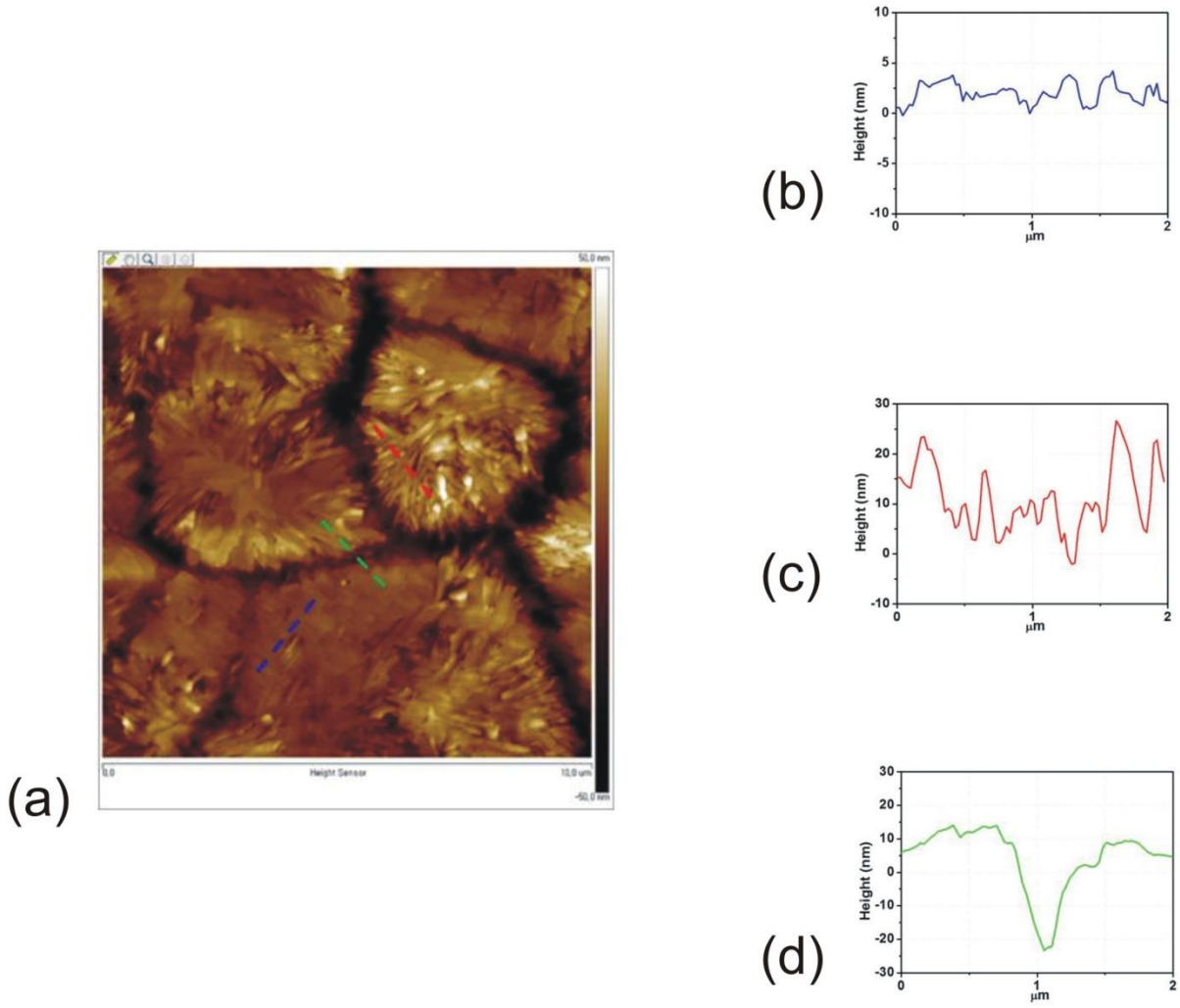

Figure S 4 AFM profiles of the surface of two different domains (blue and red) and across two of them (green line). The rms values of the structures measured along the directions indicated with blue, red and green dotted lines are 1.03nm, 6.53 nm and 9.18 nm, respectively.

e) Nanostructures of HAT5 deposited from dodecane

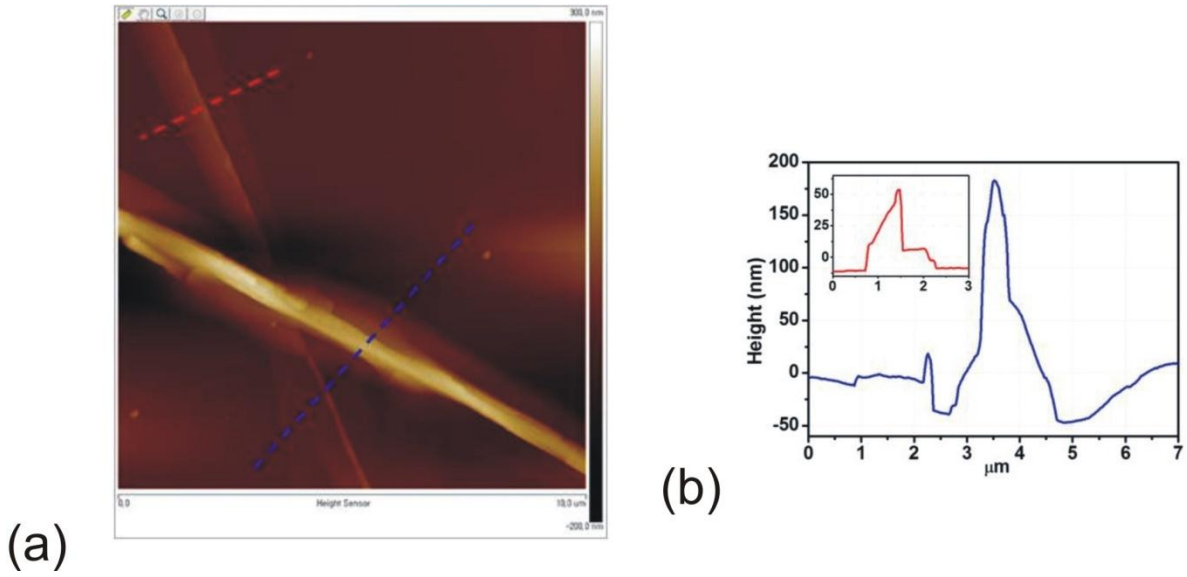

Figure S 5 AFM profiles of two crossing fibers formed by HAT5 in toluene. In the onset the profile of the smaller fiber is reported with a red line. The blue line shows the profile of the bigger fiber, the smaller fiber is also visible on the left side of the image.

2) Phase transition investigations of solvent effects on HAT5

Two solutions of HAT5 were prepared, one with toluene and a second one with dodecane. The solvent was then evaporated obtaining again a powder. The phase transition temperatures of HAT5 dried from the solvents were investigated by polarizing optical microscopy (POM).

Figure S6 (a) and (b) are the POM images of HAT5 dried from toluene at 125˚C (isotropic phase) and at 120˚C (liquid crystal phase), respectively. The phase transition occurs almost at the same temperature as pure HAT5 (Crystal 67 ˚C LC 123˚C Isotropic).

Figure S6 (c) and (d) are the POM images of HAT5 dried from dodecane at 95˚C (isotropic phase) and at 85˚C (liquid crystal phase). The transition of HAT5 dried from dodecane is not very sharp and the values can change from sample to sample. In the case of the sample shown in Figure S6, the transitions occur over a wide temperature range (roughly Crystal 50-70°C LC 90-95 °C Isotropic).

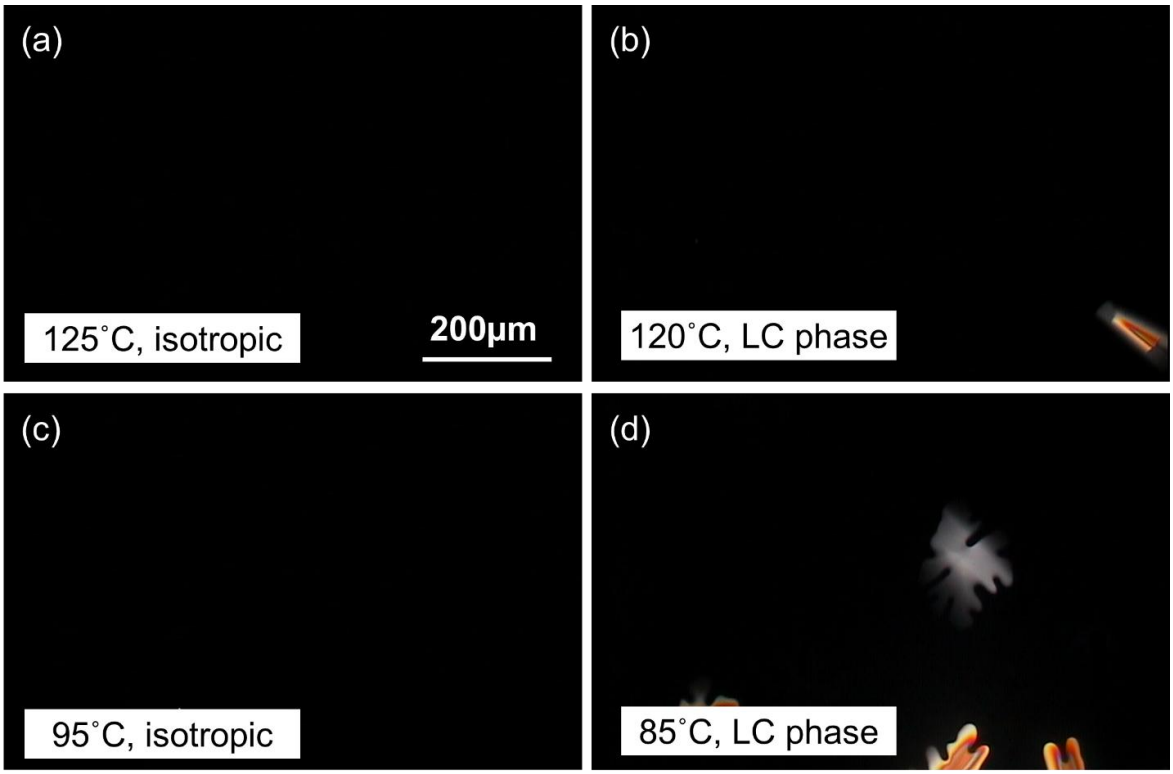

Figure S6 (a), (b) the POM images of HAT5 dried from toluene at 125˚C (isotropic phase) and at 120˚C (liquid crystal phase), and (c), (d) the POM images of HAT5 dried from dodecane at 95˚C (isotropic phase) and at 85˚C (liquid crystal phase).

3) HAT5 from different solvents on ITO coated glass

AFM images of HAT5 deposited on Indium Tin Oxide (ITO) coated glass substrates from solutions of (a) chloroform, (b) heptane and (c) dodecane. The film deposited from chloroform solution shows short grain structures, similar to the ones observed on silicon substrates but with some general differences, as described in the main text. Larger and elongated objects were obtained from heptane, exhibiting the largest differences in morphology between the different substrates. Dodecane produced large isolated fibers as on silicon substrates.

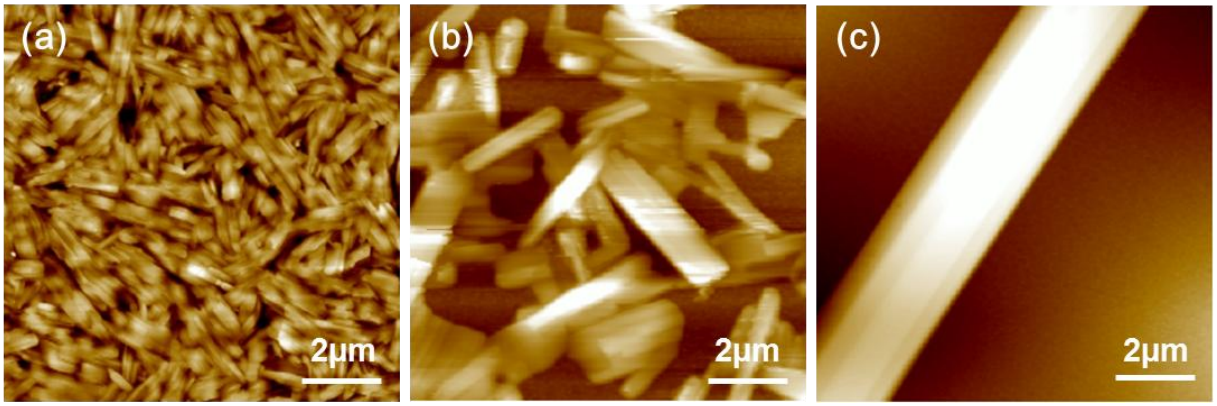

Figure S7. AFM images of the structure prepared after deposition from solutions of 6.0 mg/ml of HAT5 in (a) chloroform, (b) heptane and (c) dodecane, deposited on ITO coated glass substrates.

4) Polarized Raman spectroscopy on homeotropically aligned HAT5

HAT5 was filled into a sandwich cell (EHC, Japan) with 10 micrometer gap after heating it to the isotropic phase. It was then slowly cooled down to the LC phase to get domains with uniform homeotropic alignment that means with the columns perpendicular to the substrates. At room temperature the sample crystallizes resulting in a grainer optical texture but still fairly dark when observed in a polarizing optical microscope with crossed polarizers (Olympus BX53), indicating a decent alignment of the columns perpendicular to the substrates, even if not everywhere perfect. The sample was analyzed by polarized Raman spectroscopy and in the figure below it is reported the peak corresponding to aromatic ring stretch for two perpendicular polarizations of the incoming light. As evident, the peak intensities are quite similar indicating a decrease in the anisotropy compared to the case of molecular wires described in the article. This relates to the

difference in alignment and thus confirms the planar alignment of the fibers. Also other peaks of the bulk sample showed a decrease in anisotropy compared to the nanowire fibers. Since the liquid crystal is in the crystalline state, grains with the columnar axes not perpendicular to the substrates are also present. These are presumably responsible for the presence of small anisotropy in the spectra. The substantial decrease in the value of this anisotropy with respect to the fiber case is a clear indication that the average alignment of the columns is perpendicular to the substrates.

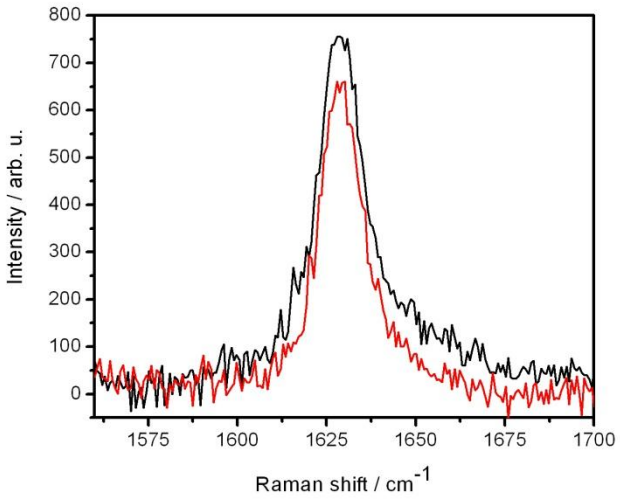

Figure S 8 Intensity of the aromatic ring stretching peak for two perpendicular light polarizations, indicated with black and red colors, respectively.

5) Electrical measurements

The electrical measurements were performed on interdigitated platinum electrodes, with a thin bottom layer of titanium, on silicon substrates. The electrodes are placed at a 2 mm distance. The sketch of the electrode structure with their dimensions is reported in the figure below.

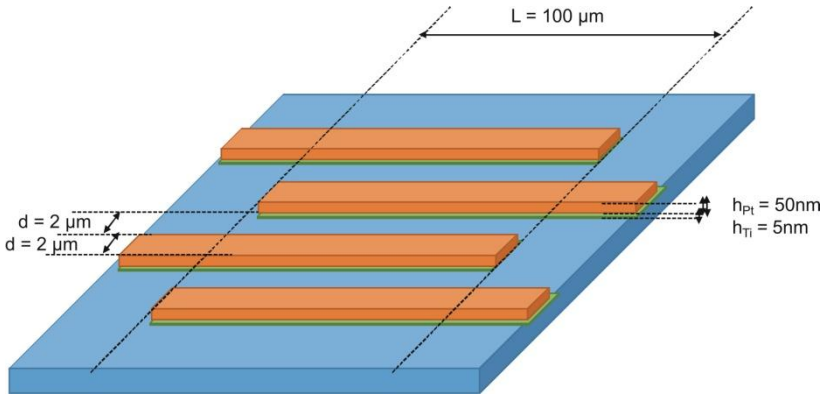

Figure S 9 Geometry of the electrodes with relative dimensions