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Conjugated Polymers Studies by Near Field Optical Microscope

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We have used the near field optical microscope (NSOM) to study the inhomogeneity as well as initiate photochemical processes in conjugated polymer films. A simple transmission-mode near field optical microscope is constructed for these purposes.

Light emitting diode (LED) based on conjugated polymers offers the flexibility of plastic and quantum efficiency approaching the inorganic LED. However the inhomogeneity is a integral part of conjugated polymers film due to the fabrication processes hence NSOM is an ideal tool for such studies at deep sub-micron length scale.

A simple transmission mode NSOM is constructed for such purposes. It is built around a commercial AFM scanning stage and a Si photodetector. The schematic of the microscope is shown in Fig. 1. A special design sample holder is used to mount a 1 cm^2, 250 μm thick Si PN planar photo-detector. This NSOM can provide topographic (AFM) and optical images simultaneously.

Fig. 2a shows the topographic image while Fig. 2b is the NSOM images of thin conjugated polymer, DP-PTV, films. The NSOM image offers the contrast at shear force image does not provide. The bright spot shown in Fig. 3 is due to the π bond breaking by the tapered fiber tip. Hence the NSOM can also be used to initiate the photochemical processes in light emiiting polymer films.

NSOM has also been apply to study the phase separation phenomena in conjugated polymer, polyanilide. Fig. 4a is the topographic and the Fig. 4b is the corresponding NSOM images. It is expected that if the NSOM contrast comes from only the sample thickness inhomogeneity then there should be a one-to one corresponding between the topographic and NSOM images. The place that is high in topographic should also be dark in NSOM images. It is clear that in certain area of the images this relation is not hold. In NSOM images, there is a bright strip, but in shear force image there is no corresponding height variations. bright strip in NSOM image but no corresponding in topographic images. Currently we are investigating the wavelength dependence of the above phenomena.

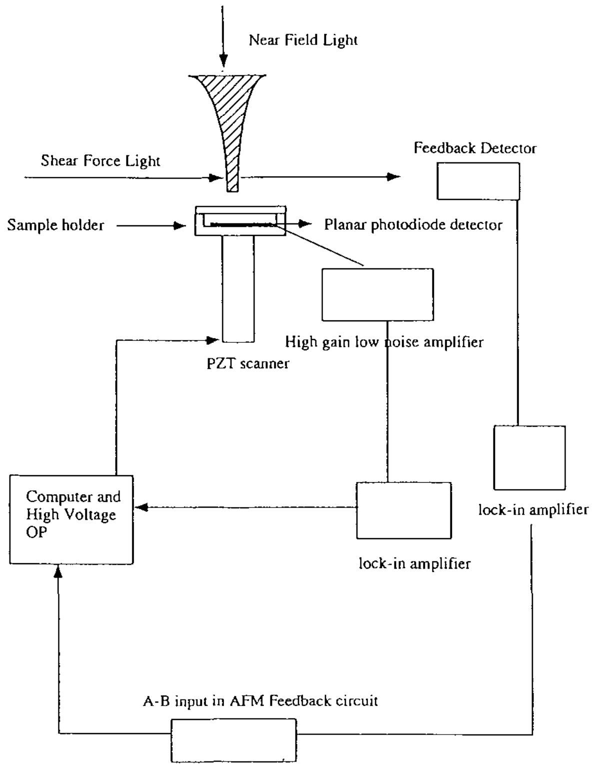


Fig. 1. The schematic of the transmission near field optical microscope.


(a) (b)

Fig. 2. The topographic and NSOM image of conjugated polymer DP-PTV film.

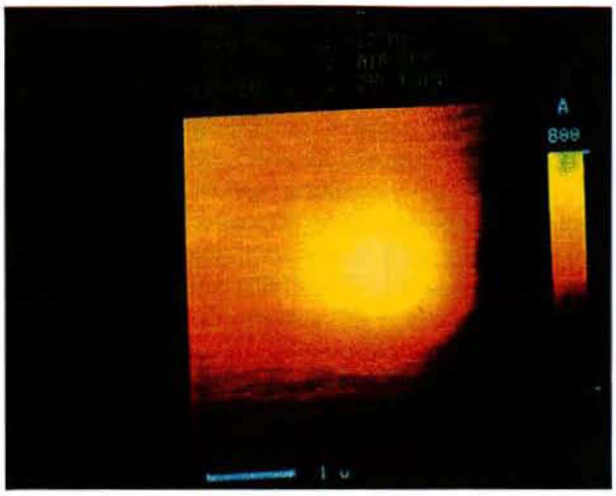
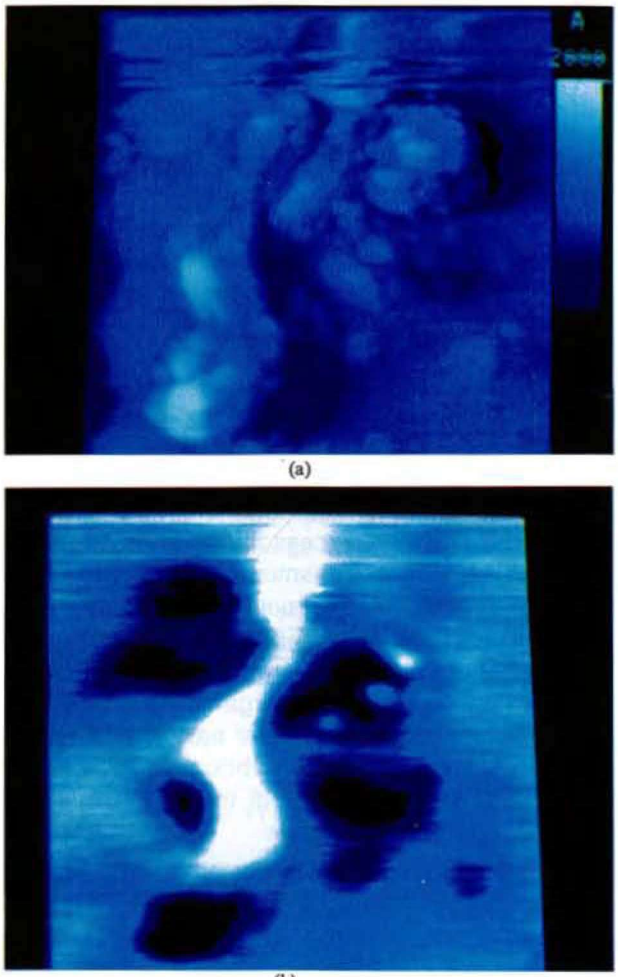


Fig. 3. The photo-chemical processes initiate at DP-PTV film by NSOM.



(a)

(b)

Fig. 4. (a) the topographic and (b) the NSOM images of polyanilide.

In conclusion, it is demonstrated that NSOM can not only be used to probe the conjugated polymer films but also to modify their properties at sub-micron length scale. It should also be possible to use NSOM to induce elimination reactions in precursor polymer films. This research is partly supported by National Sciences Council in Taiwan, ROC.

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