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NANOLITHOGRAPHY OF SEMICONDUCTOR STRUCTURES
USING SCANNING PROBE MICROSCOPY
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1 Abstract

The work reported here consisted of the fabrication and characterization of Si nano- and micro-structures useful for electronic and optical applications. The fabrications were all done in an ultrahigh vacuum chamber (UHV), and the characterization was accomplished by using air and UHV scanning tunneling microscopy (STM), atomic force microscopy (AFM), infrared (IR) spectra, high resolution transmission electron microscopy (HRTEM), scanning electron microscopy (SEM) and optical microscopy.

2 Fabrication of SiC films


3 Fabrication of patterned SiC films

We exploited the fact that fullerenes do not adsorb on SiO₂, even at elevated temperatures, while they decompose and form SiC when incident on a bare Si surface.
Therefore, we obtained SiO$_2$ patterned Si wafers, heated them to around 800°C, and
bombarded them with fullerenes. The samples were removed from the UHV cham-
ber, characterized, rinsed in HF and characterized again. The results demonstrated
that one can use this method to obtain patterned SiC films. The results, that de-
monstrated that one can obtain patterned SiC films, will appear in Nanotechnology
(in print, 1995).

4 Dynamics of photoexcited charge carriers

We have demonstrated that the STM can be operated on a nsec time scale using, for
example, the beat of the longitudinal modes of a HeNe laser at the tip-semiconductor
junction. We are currently developing a similar method that employs fast laser diodes,
and plan on characterizing the lifetime of charge carriers, on and around nanostruc-
tures, with nm and nsec resolutions. This work appeared in Appl. Phys. Lett. 64,
1995).

5 Note

Part of this work appeared in The Update, a quarterly newsletter that describes
current technologies that have evolved from the ballistic Missile Defense Organization
(BMDO)-funded projects.