Crystalline Order of Thin Polymer Films on Silicon Substrates

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Introduction

Thin polymer films in the range of 100 Å are potentially important materials in the semiconductor industry. Their state of crystallinity is a factor that is relevant to their application, but it is sensitive to the thermal processing of the devices. This experiment was designed to detect the presence of the thin polymer layer in the presence of other diffuse features.

The characteristic chain spacing of most hydrocarbon-based polymers is around 4.3 Å. Unfortunately, this spacing overlaps the diffuse peak of SiO_2, which is usually present in the heterostructure devices of interest. To distinguish them, a 2-D wide-angle scattering experiment is proposed, since the polymer peak can be more readily distinguished by its 2-D distribution.

Methods and Materials

The data recorded in Fig. 1 were obtained with a direct-reading charge-coupled device (CCD) camera manufactured by Roper Scientific. The 22×25-mm CCD chip was placed 100 mm from the sample to capture sufficient solid angle. The sample was illuminated by a 0.1×0.1-mm monochromatic beam of 8 keV at station 34-ID-C. As can be seen, the sharper polymer peak can be distinguished by its shape above the diffuse ring of the SiO_2 scattering.

Results and Discussion

Significant radiation damage occurred, as the films were found to be very sensitive. Even 60 s in the open (monochromatic) beam led to irreversible changes in the diffraction.

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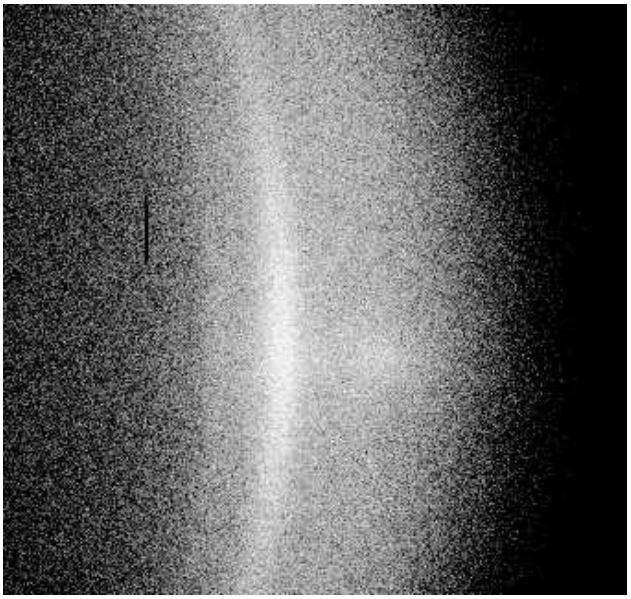

FIG. 1. Wide-angle diffraction pattern from a 150-Å polymer film spin-coated onto a 1000-Å SiO_2 film on a silicon wafer.