Surface Effects in Si Auger Spectrum

In a recent Letter Durbin and Gog[1] suggested an interesting method to derive information on the electronic states at the Si surface. Such a method requires a *careful analysis of the shape* of the Auger spectrum of Si as a function of the Ge coverage. Although Durbin and Gog's approach is promising because it allows us to identify the change of the ratio of s- to p-like components of the electronic states at the surface, we believe that a much more careful analysis of the experimental data should be performed to reach meaningful conclusions.

In a recent paper[2] we derived a procedure to get unambiguously restored Auger spectra avoiding the drawbacks of the standard iterative procedure. A correct derivation of the restored spectrum implies in *any* case an accurate determination of the energy-loss function, because even relatively small perturbations, like, e.g., temperature changes,[3] can modify such a loss function thus introducing apparent changes in the Auger spectrum. For the purpose of comparison, therefore in the present Comment we apply our procedure to analyze the data of Ref. 1. Good-quality raw data have been retrieved directly from Fig. 1 of Ref. 1 by means of an optical scanner. On assuming that the energy-loss function presented in Ref. 1 is representative also for the Ge-covered samples, we determined both the $L_{23}VV$ and $L_1L_{23}V$ lines which actually contribute in the energy range 0–120 eV (Fig. 1). It is apparent that the effect of the Ge coverage extends down to 30 eV, so that it is unlikely that all the changes are due to Si surface effects only. Two points should be made: (i) The loss function may vary due to the Ge coverage, and (ii) the Ge coverage contributes directly to the Auger spectrum in the present energy range. The information given in Ref. 1 does not allow us to discuss point (i) from the experimental point of view; however, to get some insight about these questions we derived the transfer function which allows us to broaden spectrum a of Fig. 1 to obtain spectrum c. Such a transfer function, reported in Fig. 2, shows several structures compatible with the Ge plasmon loss and plasmon gain (possibly double ionization) as well as other Ge Auger lines[4] like, for instance, $M_{23}M_{45}V$ and $L_1L_{23}M_{23}$. These results give support that point (ii) might be of some relevance, so that further measurements with higher Ge coverage are required. The probable presence of Auger lines from Ge is also apparent in the inset of Fig. 1 where the relevant difference spectra are reported.

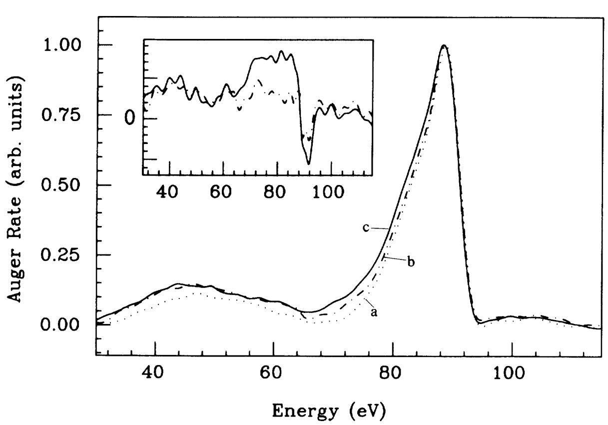

FIG. 1. Restored Auger spectra of, curve a, pure Si (dots), curve b, Si covered by 43% of a Ge monolayer (dot-dashed line), and, curve c, Si covered by 77% of a Ge monolayer (solid line). Inset: The difference spectra $b-a$ (dot-dashed line) and $c-a$ (solid line).

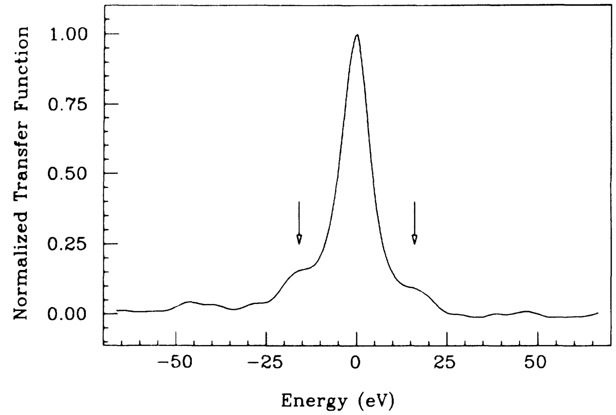

FIG. 2. Transfer function between c and a spectra of Fig. 1. The arrows are placed at a distance from zero equal to the Ge plasmon energy.

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