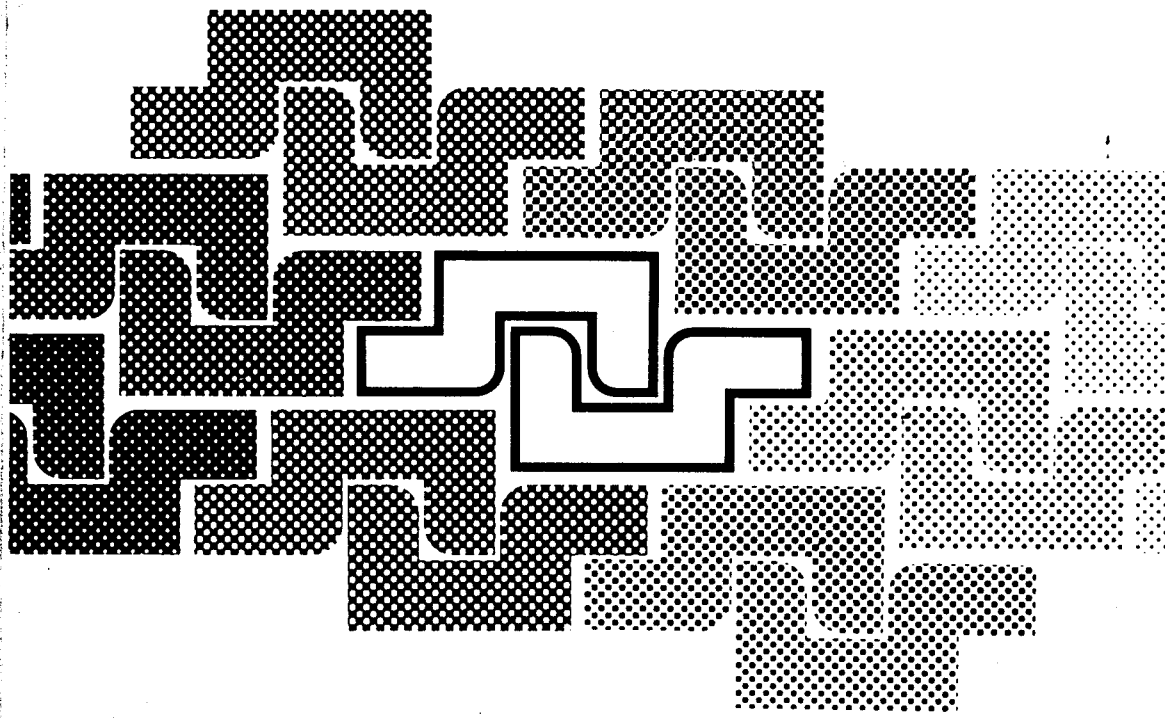

Diffusion in Materials

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DIFFUSIVITIES AND SOLUBILITIES OF VARIOUS ELEMENTS IN SILICON

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Abstract
It has been argued recently [1] that for a given process in solids involving defects (for example defect formation, diffusion, solution of impurities, etc...) the corresponding enthalpy h^i and entropy s^i have to be interconnected through the relation :

$$\frac{s^i}{h^i} = -\frac{\beta B + dB/dT|_p}{B - T\beta B - T\,(dB/dT)|_p} = F \qquad (1)$$

where β denotes the thermal volume expansion coefficient and B the isothermal bulk modulus of the host material. Thus the microscopic parameters characterizing a certain process are connected to a macroscopic quantity characterising the material itself. More specifically, the quantity s^i/h^i in our case depends solely on the bulk properties of the host crystal and it is independent on the various elements which participate in the process.
In the present work, relation (1) has been checked for the diffusion and solubility processes of various foreign atoms in semiconductor Silicon. A least square fitting gave for the quantity s^i/h^i values which deviate about 20% from the value of the bulk quantity F. In view of the large scatter of the parameters s^i and h^i reported in literature we regard that the experimental data in general follow remarkably well the predictions of relation (1).

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LONG RANGE ATOMIC H MOTION IN p-DOPED rf-SPUTTER DEPOSITED a-Si:H

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Abstract
The diffusion of hydrogen in boron doped rf-sputter deposited (rf sp) a-Si:H, prepared at rf power levels $100 \le P \le 550$ W, and target-to-substrate distance of 1", was studied by monitoring the IR spectra and secondary ion mass spectrometry (SIMS) profiles of deuterium in a-Si:H/(H,D)/H multilayers annealed in evacuated sealed tubes at temperatures $180 \le T \le 260$°C. The diffusion was found to be considerable faster than that in undoped rf-sputter deposited films previously reported by Shinar et al. [1, 2]. This enhanced diffusion is in agreement with similar results on D and H diffusion in films deposited by the glow discharge (gd) decomposition of silane [3]. The diffusion in the doped rf sp films, however, exhibits a strong power law time dependence, $D \propto t^{-\alpha}$, as seen from fig. 1, where $\Theta(t) = \int_0^t D(\tau)\,d\tau$ [4] is seen to be proportional to $t^{1-\alpha}$, where $0.6 \le \alpha \le 0.9$. This time dependence is much stronger than that reported for the doped gd films, where $\alpha \equiv 0.2$. It is, however, similar to the time dependence observed in undoped rf sp films which exhibited a significant content of SiH_2 and SiH_3 bonding configurations generally associated with microvoids. The diffusion in the boron doped rf sp a-Si:H is also discussed in relation to the doping level, H content, and the microstructural properties of these films.

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