

Hydrogenated Amorphous Silicon Nitride Deposited By Dc Magnetron Sputtering

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Abstract

The hydrogenated amorphous silicon nitride has been deposited by DC magnetron sputtering in argon, molecular hydrogen and molecular nitrogen mixture. The film has been deposited between 2 and 5 Å/s in the low deposition temperature between 100 and 400°C. The film thickness is between 0.2 and 0.4 µm. We have explored the film properties by the electrical measurements and the optical transmission. The nitrogen incorporation was studied by the FTIR spectrum analysis and the NRA and the RBS analysis.

From the detailed analysis of the IR measurements, we can see that the nitrogen and the hydrogen are incorporated in the form of Si-N, N-H and Si-H bonding. The nitrogen and the hydrogen concentrations may be evaluated.

The electrical conductivity decreases when the nitrogen concentration increases. For a low concentration of the nitrogen incorporation, the activation energy of the conductivity show a little variation. The optical absorption shifts to the high photon energy and the index refractive decreases.

The nuclear measurements analysis shows an uniform distribution of the nitrogen incorporation.

For the high nitrogen concentration, the electrical conductivity and the refractive index falls down to 10^{-12} ($\Omega \text{ cm}$)⁻¹ and 1.8 respectively. The films become transparent in the visible range.

In the sandwich measurement using metal/ hydrogenated amorphous silicon nitride on doped silicon, the material show a MIS structure behavior. This structure is stable after a thermal annealing up to 400°C. The composition of these films is near the stœchiometric composition of the silicon nitride (Si₃N₄).