SIPOS heterojunction contacts to silicon

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Deliberate introduction of controlled amounts of an oxygen-bearing species such as nitrous oxide into the deposition ambient normally used for chemical vapor deposition of polysilicon produces SIPOS, a class of silicon oxides that exhibits a wide range of physical properties. It is possible to tailor SIPOS film characteristics such as refractive index by altering the oxygen partial pressure in the deposition ambient. The addition of a dopant species converts these films from semi-insulating to a form that can be made sufficiently conductive after annealing to make them interesting for electronic applications. The potential for conveniently altering the effective mobility gap in this material suggests its use in heterojunction contact structures to silicon. Incorporation of these films into the emitter structure of an NPN bipolar transistor has been found to reduce the emitter saturation current fifty fold. This suppression of reverse injected hole transport has often been assumed to be the result of a wider gap in the SIPOS due to the presence of incorporated oxygen. However, this seems to be an oversimplification in view of microstructural studies that revealed a multi-phase structure consisting of a fine dispersion of silicon microcrystals embedded in an oxide-like matrix. Experimental results indicated a relative insensitivity to the oxygen content of the films; the hole blocking action was as effective in low oxygen content film as in high. This insensitivity to bulk film properties implied that other mechanisms, in this case the formation of an interfacial oxide layer, may be primarily responsible for the reduced hole currents.

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