Control of Resistivity in Bridgman Growth of Silicon Single Crystals for Photovoltaic Application

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The dopant impurities play a key role in semiconductor device operation. Impurity atoms with ko(equilibrium segregation coefficient) <1 are rejected by the advancing solid at a greater rate than they can diffuse into the bulk of the melt. Most values for the commonly used dopants for silicon are below 1, which denotes during growth the dopants are rejected in to the melt. In melt crystal growth process, with the start of solidification at a given crystal-melt interface, segregation take place and the rejected impurity atoms begin to accumulate in the melt layer near the growth interface and diffuse in the direction of the bulk of the melt. We will focus on the horizontal Bridgman growth system to analyze the transport phenomena numerically. Approach on the substitution of boron by gallium in p-type Czochralski-grown silicon crystal has been pursued in a recent activity. Since reduced light-induced degradation of minority carrier lifetime was observed, this approach seems to be very promising. The only disadvantage is the low segregation coefficient of gallium in silicon, resulting in a higher resistivity variation over the crystal length compared to boron doping.