METHODS FOR PRODUCING A SINGLE CRYSTAL SILICON INGOT USING BORIC ACID AS A DOPANT AND INGOT PULLER APPARATUS THAT USE A SOLID-PHASE DOPANT

Methods for producing a silicon crystal silicon ingot are disclosed. The ingot is doped with boron using solid-phase boric acid as the source of boron. Boric acid may be used to counter-dope the ingot during ingot growth. Ingot puller apparatus that use a solid-phase dopant are also disclosed. The solid-phase dopant may be disposed in a receptacle that is moved closer to the surface of the melt or a vaporization unit may be used to produce a dopant gas from the solid-phase dopant.

FIG. 2