SUMMARY ~~OF THE INVENTION~~

The present disclosure~~invention~~ provides a slurry composition for chemical mechanical polishing (CMP) of a phase-change memory device that can polish a phase-change memory device at a high rate, can achieve high polishing selectivity between a phase-change memory material and a polish stop layer (*e.g.*, a silicon oxide film), and can minimize the occurrence of processing imperfections (*e.g.*, dishing and erosion) to provide a high-quality polished surface; and a method for polishing a phase-change memory device using the CMP slurry composition.

The present disclosure~~invention~~ further provides a slurry composition for chemical mechanical polishing of a phase-change memory device that can cause substantially no change in the composition or phase of a phase-change material before and after polishing, can minimize the occurrence of surface imperfections (*e.g.*, scratches, defects, corrosion and polishing residues) to provide a clean polished surface, and includes no abrasive particles to prevent the surface of a wafer from being contaminated by abrasive particles; and a method for polishing a phase-change memory device using the CMP slurry composition.

In accordance with one embodiment~~aspect~~ of the present disclosure~~invention~~, there is provided a slurry composition for chemical mechanical polishing (CMP) of a phase-change memory device which comprises deionized water and iron or an iron compound, and which does not include abrasive particles. The CMP slurry composition can include other processing aids suitable for use in a CMP process, such as but not limited to a pH adjusting agent as discussed here, so long as the composition does not include abrasive particles.

The phase-change memory device can include a metal alloy or a chalcogenide.

The phase-change memory device can include at least one compound selected from InSe, Sb_2Te_3, GeTe, $Ge_2Sb_2Te_5$, InSbTe, GaSeTe, $SnSb_2Te_4$, InSbGe, AgInSbTe, (GeSn)SbTe, GeSb(SeTe) and $Te_{81}Ge_{15}Sb_2S_2$.

The iron or iron compound can be metal iron or a compound containing iron in its molecular structure.

The iron or iron compound can include an ionic iron compound or an iron chelate compound.

The iron or iron compound can be present in the slurry composition of the invention in an amount of about 0.01 to about 10% by weight, based on the total weight of the slurry composition.

The slurry composition can have a pH of about 2 to about 10.

The CMP slurry composition can further comprise a pH-adjusting agent.

The pH-adjusting agent can include at least one acid selected from nitric acid, phosphoric acid, sulfuric acid, hydrochloric acid, and organic carboxylic acids having a pKa of 6 or less.

In accordance with another embodiment~~aspect~~ of the present disclosure~~invention~~, there is provided a method for polishing a phase-change memory device using the CMP slurry composition. In an aspect, there is provided a method for polishing a phase-change memory device comprising a phase change layer, wherein the method comprises contacting said phase-change material layer in the absence of abrasive particles with a CMP slurry composition comprising deionized water and iron or an iron compound, wherein the iron or iron compound is present in an amount of about 0.01 to about 10% by weight, based on the total weight of the slurry composition.

A phase-change memory device can be fabricated by applying an insulating material to a semiconductor wafer to form an insulating layer, planarizing the insulating layer, patterning the planar insulating layer, and applying a phase-change material to the patterned insulating layer to form a phase-change material layer; and the CMP slurry composition can be brought into contact with the phase-change material layer to polish the phase-change material layer until the insulating layer is exposed.

The phase-change material layer can be polished by applying the CMP slurry composition to a rotating polishing pad and bringing the polishing pad into contact with the phase-change material layer under predetermined pressure conditions to polish portions of the phase-change material layer by a frictional force.

In yet another embodiment~~aspect~~ of the present disclosure~~invention~~, there is provided a phase-change memory device polished by the polishing method.