CLAIMS

1. A chemical mechanical polishing system, comprising:

a platen to support a polishing pad having a polishing surface; and

a pad cooling assembly including

an arm extending over the platen, the arm comprises a support plate having an aperture therethrough,

a nozzle suspended by the arm and coupled to a source of coolant fluid, the nozzle positioned to spray coolant fluid from the source onto the polishing surface of the polishing pad, wherein the nozzle is oriented to spray coolant fluid through the aperture, and

an opening in the arm adjacent the nozzle and a passage extending in the arm from the opening, the opening positioned sufficiently close to the nozzle that a flow of coolant fluid from the nozzle entrains air from the opening, wherein the opening is provided by a gap between an inner surface of the aperture and the nozzle.

2. The system of claim 1, wherein a bottom of the nozzle is positioned above the support plate.

3. The system of claim 1, wherein a portion of the nozzle extends into the aperture.

4. The system of claim 1, wherein a top of the support plate is uncovered.

5. The system of claim 1, wherein the arm comprises a housing covering the support plate.

6. The system of claim 5, comprising a passage through the housing to connect an interior of the housing to external atmosphere.

7. The system of claim 5, wherein a plurality of nozzles are nozzle suspended by the arm, and plurality of nozzles are in a common chamber of the housing.

8. The system of claim 5, comprising a plenum extending laterally through the support plate from at least one side wall of the aperture, wherein the opening is provided by the plenum.

9. The system of claim 5, comprising a plurality of plenums extending laterally from a plurality of different side walls of the aperture through the support plate, wherein the opening is provided by the plurality of plenums.

10. The system of claim 1, wherein the nozzle comprises a convergent-divergent nozzle.

11. The system of claim 1, comprising a controller configured to be coupled to the coolant source and to cause the coolant source to deliver the coolant fluid to the nozzle at a rate of 50-100 standard liters per minute.

12. A method of temperature control for a chemical mechanical polishing system, comprising:

supporting a nozzle on a support arm, the arm comprising a support plate having an aperture therethrough;

delivering a coolant fluid from a coolant source through the nozzle, the nozzle being oriented to spray coolant fluid through the aperture; and

entraining air from an opening in the support arm in a flow of coolant fluid from the nozzle so that a mixture of coolant fluid and entrained air is directed onto a polishing pad, the opening being provided by a gap between an inner surface of the aperture and the nozzle.

13. The method of claim 12, wherein flowing the coolant fluid through the nozzle reduces a temperature of the coolant fluid.

14. The method of claim 12, wherein the coolant fluid is a gas.

15. The method of claim 14, comprising forming the coolant fluid by chilling air, by evaporating liquid nitrogen, by evaporating liquid ethanol, by evaporating of liquid isopropyl alcohol, and/or by sublimating dry ice.

16. The method of claim 12, wherein the fluid is a liquid.

17. The method of claim 16, wherein the fluid comprises liquid nitrogen, liquid water, liquid ethanol, and/or liquid isopropyl alcohol.

18. The method of claim 12, comprising dispensing the mixture of coolant fluid and entrained air onto the polishing pad at a temperature below 0º C.

19. The method of claim 18, comprising dispensing the mixture of coolant fluid and entrained air onto the polishing pad at a temperature between -70 to -50º C.