Kimerling Group at MIT - 2024
Problem Statement script

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Anu: As you know, Justin, semiconductor manufacturing is very water intensive. It relies on water at all stages of the process.

Justin: The chemical-mechanical-planarization, or CMP, process alone uses vast amounts of water; it amounts to about 40% of the industry's water consumption. A research fab like ours might use up to 30,000 gallons of water in a day, but a high volume commercial fab can use millions of gallons of water every day. And the waste water is dirty - acidic with slurry particles mixed in.

Anu: Right, but CMP is an absolutely essential process in making chips. Look at this presentation I gave to some students last month to explain why we need to use it as part of the chip-making process.

(narration for slides) We usually start with a pure silicon substrate, and let's say the first step is to put down a silicon dioxide or SiO_2 layer. Next, we want to etch the SiO_2 layer, and we're left with a non-planar surface. Suppose we want to put a nitride layer on top of this. You can see there's a bump or a kink, it's not flat. The surface needs to be absolutely flat for the next photolithography step.

So what we do instead is to put down a thick layer of nitride, more than we need. Then we use CMP to polish it down so it's flat. So we have to do CMP every step so that we get a nice planar surface for the next photolithography layer.

Justin: It's a pretty complicated process and it uses ultrapure water from beginning to end. The question is, what can we do with all that waste water when we're finished with it?