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Buffing Out Nanoscopic Imperfections

By using a tool called a Chemical Mechanical Polisher, it is possible to reduce the roughness of the semiconductor InSb to about half a nanometer. That is, assuming you know which settings to use. A high pressure between the polishing pad and semiconductor will give a consistent polishing rate across the whole semiconductor, while a higher pad speed gives a smoother finish.

Development of exceptional electronic devices requires the use of exceptional materials. Both intrinsically in the choice of material, but also in the quality of that material. InSb (indium antimonide) is one such exceptional material, which is uniquely capable of absorbing and detecting infrared radiation. Humans cannot see infrared radiation (though we can feel it with our skin), but InSb can.

While InSb has top of class potential, it must be physically structured in such a way as to meet this potential. One of the most important aspects of modern electronics development is the polishing phase, wherein the device being developed achieves a flat surface. As when building a house, if the foundation is solid, the house can be solid. The flat surface of electronics components can improve the performance of the device, as well as prevent device failure when stacking layer upon layer during the fabrication process. A key tool for flattening these surfaces is the Chemical Mechanical Polisher (normally referred to by the letters CMP) which, as the name suggests, uses a chemical component and a mechanical component to polish something. The chemical portion weakens the surface, and the mechanical portion then carves it away, nanometer by nanometer, leaving behind a surface with a surface roughness of about half a nanometer in our case. To achieve this level of smoothness, the proper polishing parameters must be used, and it was found through my work that using a higher pressure between the pad and the semiconductor polished the whole surface evenly, while using a high speed on the polishing pad gave a smooth surface.

While polishing, debris can build up which would ruin the flat surface we're aiming for, and so some various cleaning techniques were also employed, to great effect. The first is putting the semiconductor into an ultrasonic bath, which blasts it with sound waves, dislodging any surface particles. An even better option would have been the more powerful megasonic bath, but that's going to have to wait for future tests. The final cleaning method used was a sponge made out of a material called polyvinyl alcohol. It works much like a kitchen sponge, but removes dirt that is so small you need a microscope to see it. Baths and sponges appear to be a solid combination, even on the nanoscale.

All in all, exceptional devices require exceptional materials and foundations, and the combination of InSb and CMP seems to fit that bill perfectly.