Keeping the heat down

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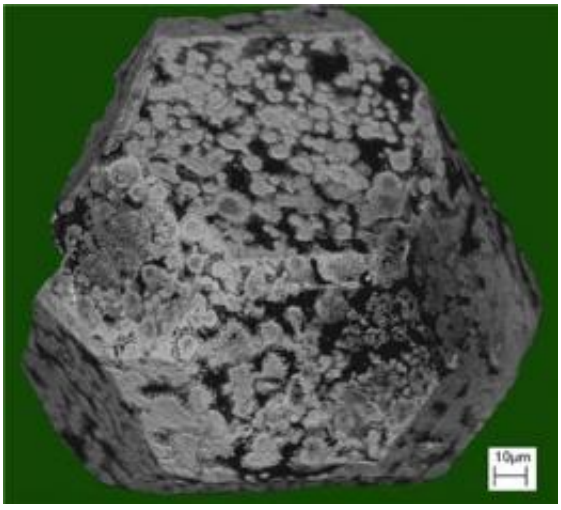

Diamond crystal with a carbide film (white). © Fraunhofer IFAM

(PhysOrg.com) -- Electronic products are having to accommodate more and more components, all of which generate heat. Too much heat could put laptops and other devices out of action, so manufacturers equip them with metal plates to discharge it. A new composite can do this better.

While portable computers were still rather cumbersome several years ago, they now easily fit inside small briefcases. This is because the components on the substrates and microchips are shrinking in size with each successive model. They are also spaced closer together, allowing more circuits to be accommodated on each chip. All of these components generate radiant heat, much like small power plants. The more components are packed into a limited space, the more difficult it is

to dissipate the heat. And too much heat could put the electronics out of action.

The components and connecting elements can only withstand temperatures of 90 to 130 degrees Celsius. Manufacturers therefore mount a small copper or aluminum plate underneath them to conduct the heat away. The plate, in turn, is soldered to ceramic components or silicon (the main constituent of the chip). If this system heats up, the metal plate expands about three or four times as much as the silicon or the ceramics. This causes tension which can lead to cracks in the soldered joints, so there are limits to how far components can be miniaturized.

Industrial users are calling for a material with special properties that can efficiently dissipate heat even in devices with densely packed components and that can give increasingly miniaturized electronics a longer life. The material needs to be able to conduct heat even better than the aluminum or copper materials used so far, but should not expand to a greater extent than ceramics or silicon at high temperatures. Such a material has now been developed by researchers at the Fraunhofer Institute for Manufacturing Engineering and Applied Materials Research IFAM in Dresden together with industrial partners including Siemens and Plansee as part of the EU project “ExtreMat”. The researchers have even surpassed the already relatively high thermal conductivity of copper: “We did this by adding diamond powder to the copper. Diamond conducts heat roughly five times better than copper,” says IFAM project manager Dr. Thomas Schubert.

“The resulting material expands no more than ceramics when heated, but has a conductivity one-and-a-half times superior to copper. This is a unique combination of properties.” However, it isn’t easy to unite copper and diamond. The researchers had to find a third ingredient to chemically bond the two materials. “One ingredient we can use to

achieve this is chrome. Even small amounts form a carbide film on the diamond surface, and this film easily bonds to copper," Schubert explains. First demonstrators of the material have already been produced.

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