Furthermore, other non-classic MHC-I or MHC-I-like molecules require B2M for their expression. For example, HLA-H (also known as HFE, human hemochromatosis protein) is a class-I-like molecule involved in iron metabolism that requires association with B2M for expression. Abnormal expression of HLA-H, either from mutations in *HFE* or abnormal B2M expression, results in iron overload, a condition called hemochromatosis, which can lead to cirrhosis of the liver. Thus, using a cell line lacking B2M expression to generate cells for transplant of hepatocytes for liver failure patients, for example, may have unforeseen effects.

Additional changes could also be made to the PSC line to improve safety and efficacy. For example, inclusion into cells of suicide genes, such as thymidine kinase (a built-in kill switch that can be triggered in the presence of ganciclovir if donor cells show evidence of transformation), could be one fail-safe mechanism. The inclusion of additional molecules like HLA-G, which also binds inhibitory NK cell receptors, may also afford greater protection from immune-mediated damage.

Thus, the report from Gornallus *et al.*² addresses the two greatest challenges in the field of organ and cell transplantation: availability of donor organs and tissues as well as protection from the host's immune response. In solid organ transplantation HLA matching, while desirable, is seldom achieved (i.e., most organ transplant recipients are unmatched to maximize the opportunity to receive a transplant). Immunosuppression is required to counteract the rejection response that is primarily fueled by these HLA differences. The availability of organs or tissues where HLA matching is not a concern would not only provide a potentially unlimited source for transplants but likely allow for minimization or perhaps, with future modifications, even elimination of immunosuppression. This new strategy to avoid both NK-cell- and T-cell-mediated injury has important implications with regards to the development of an off-the-shelf donor cell line that could be used to generate tissues and organs for the thousands of patients currently awaiting this lifesaving therapy.

COMPETING FINANCIAL INTERESTS

The authors declare no competing financial interests.

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Turning silver dust into electronics

Robots, bionic limbs, and wearable sensors rely on large and stretchable electronics to receive and transmit information. But making conducting materials that are elastic,

Exploring the importance of each constituent in their ink, Matsuhisa *et al.*¹ demonstrate that its composition is critical to the formation of silver nanoparticles. They also provide

strong, and conform to different shapes is a challenge. In a recent paper, Matsuhisa *et al.*¹ find that silver flakes' ability to form nanoparticles *in situ* can be exploited in the printing of high-performance, flexible electronics.

There are two general types of elastic, conducting materials: those that are intrinsically stretchable, such as liquid metals or conducting polymers; and those that are engineered as conducting pathways. One way to fabricate conducting pathways is by generating microstructures (e.g., accordion and serpentine patterns), which can be used for small flat areas. Another approach, which can enable printability of large materials, is to engineer them by self-assembly of conducting pathways using carbon nanotubes and metal nanowires, flakes, and nanoparticles. Of these, metal nanoparticles have shown the highest conductivity at the highest strain, but nanoparticles cannot be easily patterned to make materials or films.

The recent discovery by Matsuhisa *et al.*¹ addresses this limitation by showing that silver nanoparticles can be formed *in situ* from silver flakes. Although the authors had previously used silver flakes in self-assembly of conductors, silver nanoparticles had not been observed, probably due to differences in the selection of materials and processing conditions. Mixing silver flakes with fluorine rubbers and surfactant, the scientists create an ink that is compatible with printing. Repeated heating of the ink during material preparation is critical to the formation of nanoparticles, with a temperature of 120 °C yielding the best conductivity and stretchability.

evidence that the nanoparticles mediate the desirable characteristics of their conductors, particularly conductivity, stretchability, and cyclic durability. Testing the conductor in a printed elastic pressure and temperature sensor that can be laminated onto textile substrate, the scientists show the device is functional, even when stretched by 250%.

"Nanoparticles endow better conductivity because they lower the threshold for percolation," says George Malliaras, a professor in the Department of Bioelectronics at École des Mines de Saint-Étienne in France. Malliaras explains that "if you were trying to cross a river, the percolation threshold would be the concentration of logs you would need to create a continuous path from one bank to the other." Similarly, for an electron traveling through silver flakes, the nanoparticles lower this threshold, increasing conductivity. "There is also improved resistance to wear," he says, "because tear will be arrested by the nanoparticles."

Prostheses that can 'feel', on-skin health-monitoring sensors, and robots designed to surpass human stretchability could all benefit from the improved conductors. "The approach is advantageous whenever you need to make large electronics that are not flat," says Malliaras. And although silver provides a rich seam of new possibilities for flexible electronics, substituting it for cheaper metals could reduce costs, extending the applicability of the approach.

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