When it comes to churning out electrons, metal glass beats plastics

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By adding carbon nanotubes to a glass-like metal compound, researchers have devised a new breed of field emission electrodes. This technology, which produces a stream of electrons, may have promising applications in the consumer electronics industry.

Field emission devices, which produce a steady stream of electrons, have a host of consumer, industrial, and research applications. Recent designs based on nanotubes and other nanomaterials embedded in plastics show initial promise, but have a number of drawbacks that hinder their wide-scale application. The embedded nanotubes, which serve as the source for the electrons, also enable the normally inert plastic to conduct electricity. This has the desired effect of producing a versatile and easily manufactured field emission device. But since plastics are, by nature, poor conductors of electricity, they require a high concentration of nanomaterials to function. Plastics also have low thermal stability and do not hold up well under the excess heat produced by prolonged operation.

A team of researchers from Monash University in Australia, in collaboration with colleagues from CSIRO Process Science and Engineering, has developed a promising and easily manufactured replacement for plastics: amorphous bulk metallic glass (ABM). These ABM alloys form amorphous materials as they cool, giving them more of a glass-like behavior. In a paper accepted for publication in the AIP's journal Applied Physics Letters, the researchers used an alloy made from magnesium, copper, and gadolinium. This metallic glass has many of plastics' desirable features. It can conform to a variety of shapes, be

produced in bulk, and serve as an effective matrix for the nanotubes. Besides its high conductivity, the metallic glass' highly robust thermal properties mean that it can withstand high temperatures and still retain its shape and durability. According to the researchers, these advantages, alongside excellent electron emission properties, make these composites one of the best reported options for electron emission applications to date.

Though other composites of bulk metallic glass and carbon nanotubes have been reported before, this is the first time that such a system is being used for a functional device, such as for field emission. Electron microscopes, microwave or X-ray generation, nano-electronics, and modern display devices are all examples of the potential applications of this technology, the researchers note.

More information: "High performance bulk metallic glass/carbon nanotube composite cathodes for electron field emission" is published in *Applied Physics Letters.*

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