New Research Shows Competing High Technology Conductors Still Far from Competitive with Copper

The International Copper Association (ICA) announced today that—despite significant progress—emerging conductive materials are still a long way from being competitive with copper. The research, undertaken by IDTechEx, focuses on pure nanocarbon materials, copper nanocomposites and high temperature super conductors, and suggests that these materials—though still in relative infancy—do not have the requisite properties or costs to threaten the current market.

Improved conductors would theoretically have lower resistance, high current carrying capacity, lighter weight, smaller size and a reduced temperature dependence. However, according to Dr. Richard Collins, Technology Analyst at IDTechEx and author of the research, none of the researched materials tick all the boxes.

Colin Bennett, Global Manager, Market Analysis and Outreach, ICA notes, 'It seems clear from the study that competing conductors are some way from gaining a foothold in the market, and copper will remain a cornerstone of technological innovation in future.'

Pure Nanocarbon Materials

Since their inception in the early 1990s, carbon nanotubes (CNTs) have been identified as a potential replacement for copper. In their nanoscale form, their high ampacity, thermal conductivity, flexural strength, lower density and temperature coefficient of resistance give them some significant advantages over copper. However, successfully translating these benefits to the macroscale is proving very challenging.

The progression to macroscale CNT wires, yarns and tapes has seen significant improvements over the past 10 years, and this is expected to continue, but the hardest steps are still to come and we will not see CNT yarn used in any mainstream applications for at least another 10–15 years.

Copper Nanocomposites

Sometimes called nanoalloys or ultraconductive copper, copper nanocomposites refer to the inclusion of conductive material—such as CNTs or graphene—into a copper matrix. Due to their exceedingly low levels of electrical resistance, which has been measured as high as 118% IACS, copper nanocomposites could see use in a range of electrical applications, including magnet wires in motor stators; copper foil in batteries; circuit boards; bonding wire for lead frame to chip; chip-level connection; power transmission cable; and power cable.

However, common challenges in high volume manufacturing of usable wire with uniform properties, cost-effectiveness, and availability of nanocarbon materials from the upstream supply-chain is holding these materials back. Most of the research is carried out at university level.

High Temperature Superconductors

High temperature superconductors (HTS) are the most mature and extensively tested of these emerging conductors. They provide zero resistance solutions when cryogenically cooled to below their critical temperature.

With cable that transmits three to five times the power of copper cable helping minimize land use in urban areas; zero resistance cable minimizing power loss; and power that transmits at higher current and lower voltage, HTS have already been trialed in a number of projects.

According to the research, processing costs are the greatest challenge for HTS. ‘To warrant large-scale adoption, cost needs to reach $20–30 per kiloamp meter,’ says Richard.

About the International Copper Association (ICA)

ICA brings together the global copper industry to develop and defend markets for copper and to make a positive contribution to society’s sustainable development goals. Headquartered in Washington, D.C., ICA has offices in four primary regions: Asia, Europe and Africa, Latin America and North America. Copper Alliance programs and initiatives are executed in nearly 60 countries through its regional offices. For additional information, please visit www.copperalliance.org.

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