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Technology for Licence

Room temperature compressed air-stable conductive copper films

In brief

This invention uses a sulfated polymer capping agent to fabricate air-stable copper particles. The particles can be compressed at room temperature to fabricate free-standing conductive copper films or deposited onto a substrate to form supported electrically conductive products.

The enhanced stability (significantly better than a commercially available copper foil) means the resulting films maintain high conductivity over a longer period and reduces the need for additional protective coatings or encapsulation. The sub-micron scale particles allow for the creation of more precise and efficient components.

The compression-based method eliminates the need for high-temperature sintering processes and specialised inert or reducing atmospheres, offering a cost-effective and efficient solution for high-performance copper film production.

The technology was first demonstrated using seaweed derived κ-carrageenan (κ-CGN), a naturally occurring sulfated polysaccharide. A 1% weight/volume loading of κ-CGN:

- Delayed the on-set of aerobic oxidation to temperatures >183 °C
- Average particle size of 227 nm
- Electrical resistivity of film is 2.33 x10-8 Ωm

Different weight loadings of κ-CGN (0.5% w/v and 1.5% w/v) and other sulfated polymer capping agents (red and brown algae derivatives) allow tuning of particle size and similar material properties.

The technology has been demonstrated at gram scale and via a continuous flow reactor.

More details: Pereira, H.J., Makarovsky, O., Amabilino, D.B. et al. Room temperature compressed air-stable conductive copper films for flexible electronics. npj Flex Electron 8, 44 (2024)

Key benefits:

- Excellent conductivity, flexibility and mechanical stability
- Compression-based manufacture – no need for thermal sintering
- Air-stable Cu inks and printed films
- Adheres to principles of green chemistry

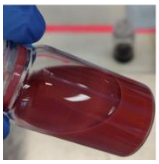

Fig 1: lab-prepared Cu ink

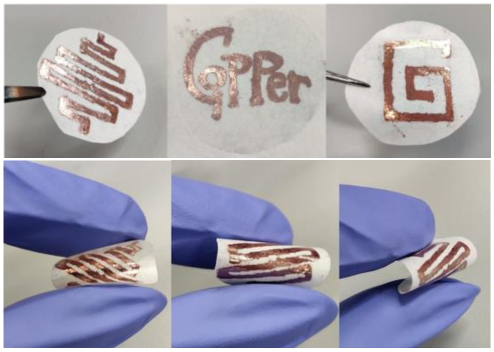

Fig 2: various Cu patterns on filter paper and physical deformation - no delamination of the Cu film occurs upon bending

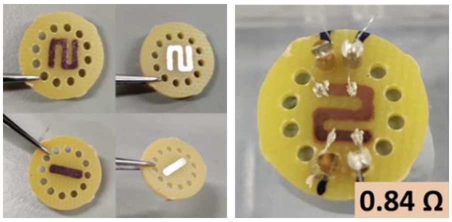

Fig 3: smooth and highly reflective Cu patterns on PCB substrates and a typical sample used for four-terminal electrical measurements of films on PCB substrates

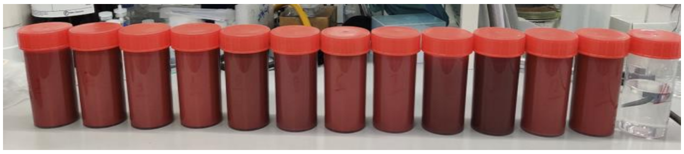

Fig 4: Cu ink produced at larger scale in a continuous flow reactor

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