Flexible Transparent Conductive Layers by Electrospinning

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Introduction and Market Needs

Transparent conductive coatings are of increasing importance for almost all kinds of modern electronics.

Requested properties are:

- High Transparency
  - High Conductivity
    - Flexible and Stretchable
- Cost Efficiency
  - Rapid Process
    - Large Area Coating

State of the Art

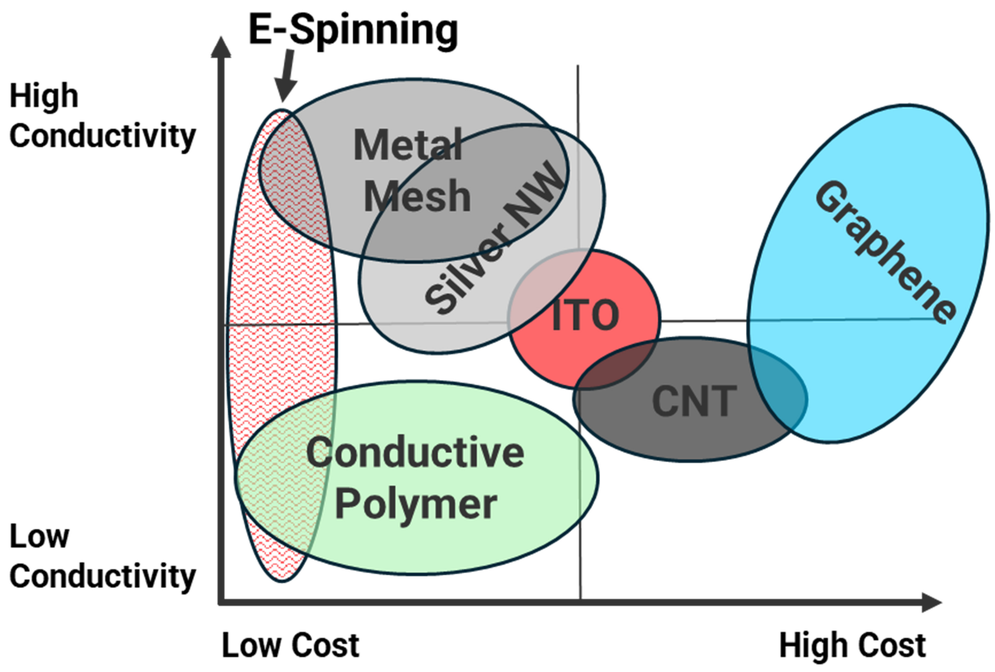

Fig. 1. Overview about various transparent conductive coating materials and goal for E-Spinning

INM Approach

INM uses electrospinning (E-Spinning) to form thin conductive fibers for an effective percolation network.

Core Results and Benefits

- Low material consumption
- Rapid large area coating
- Extremely high aspect ratio conductive fibers
- Net transparency > 90%
- Haze: below 2%
- Sheet resistance down to 4 Ω/sq
- Stretchable (up to 20%), 3D-forming, structurable
- Suitable for flexible devices, wide range of substrates
- Cost efficient application: ca. 2 €/m²

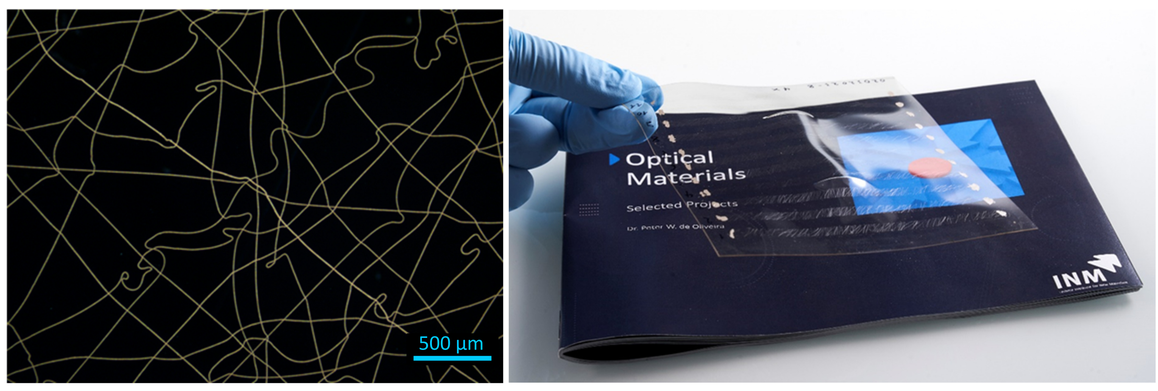

Fig. 4. Light microscopic image of E-Spinning fibers (left) and photo of structured, electrode.

Product Applications

- Transparent Electrodes for flexible Displays
- Sensors ➔ Proximity Sensor
- Antennas
- Photovoltaics
- Antistatic Coatings
- Wearables
- Transparent Heaters
- Skin Patches

Fig. 5 Proximity Sensor, exhibit shown at Hannover Messe

Processing

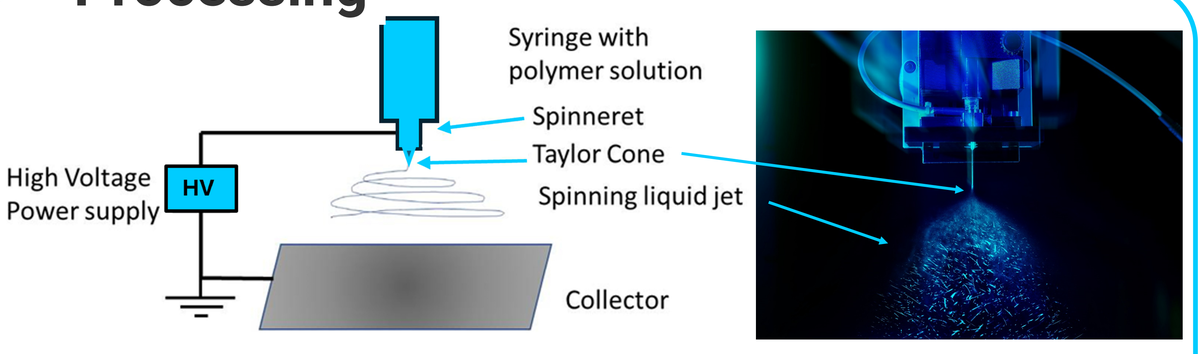

Fig. 2. Scheme of E-Spinning (left) and photograph of real E-Spinning fiber formation (right)

E-Spinning Fibers are:

- a) conductive after heat treatment
- b) highly conductive after following metallization.

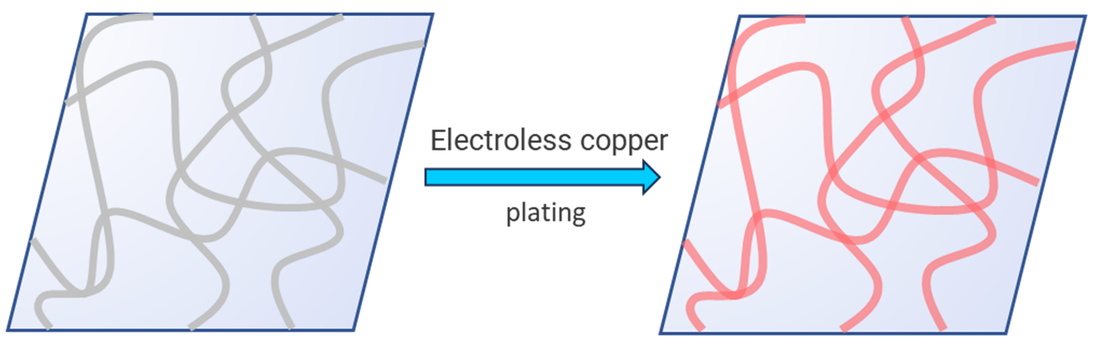

Fig. 3: Scheme of metal plating E-Spinning fibers, process is being developed towards an industrial application.

Outlook

Process will be scaled on the new E-Spinning device at the roll-to-roll foil coating machine in the Innovation Center IZI.

Fig. 6 Part of the Roll-to-Roll coating machine in the Innovation Center INM in clean room conditions (left) and the attached new electrospinning machine (right).

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