



# Highly conductive PEDOT materials for all-polymeric flexible transparent heaters and thermoelectricity

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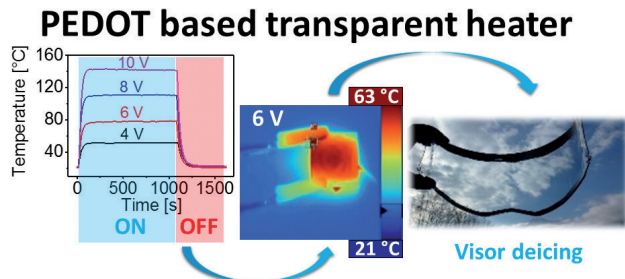
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## LABORATORIES : INAC, LITEN

During this thesis we developed one of the most conductive PEDOT-based material for future optoelectronic and thermoelectric applications. First our materials were fully characterized and the interesting properties for the targeted applications were investigated using techniques available in different laboratories in Grenoble (ESRF, INAC, Liten, PTA nanocharacterisation facilities of CEA). In particular, not alone are our materials very conductive, but they also are highly transparent. Finally they were investigated as thermoelectric materials,

transparent electrodes in solar cells and we also demonstrated a novel application of PEDOT as transparent heater. Noteworthy, our PEDOT materials can heat above 120 °C under a bias of 12 V, a result that opens the route for future applications of de-icing or defogging windshields or other surfaces during winter.

These experimental results are comforted by a theoretical physical model; and a prototype of a visor de-icer has also been demonstrated to highlight this new application .



Left: temperature response time under different bias, middle: Thermal image showing the uniform heating, right: visor de-icer prototype.

## OUTCOMES

- [1] Structure and dopant engineering in PEDOT thin films: practical tools for a dramatic conductivity enhancement, Chem. Mater. 28, 3462 (2016).
- [2] All polymeric flexible transparent heaters, ACS Appl. Mater. Interfaces 9, 27250 (2017).

**Patent:** Liten patent "Utilisation à titre d'élément chauffant d'un films polymérique conducteur et transparent à base de polymères poly(thio-séléno)-phéniques" (n° WO2018069286A1)

**Oral presentations:** EMRS-Fall, Warsaw, Poland, 2016; Orzel, Szczyrk, Poland, 2017; Synohe, Annecy, France, 2017.