WATER-BASED ELECTRICALLY CONDUCTIVE ADHESIVE FOR PERC-TYPE SHINGLED SOLAR CELLS

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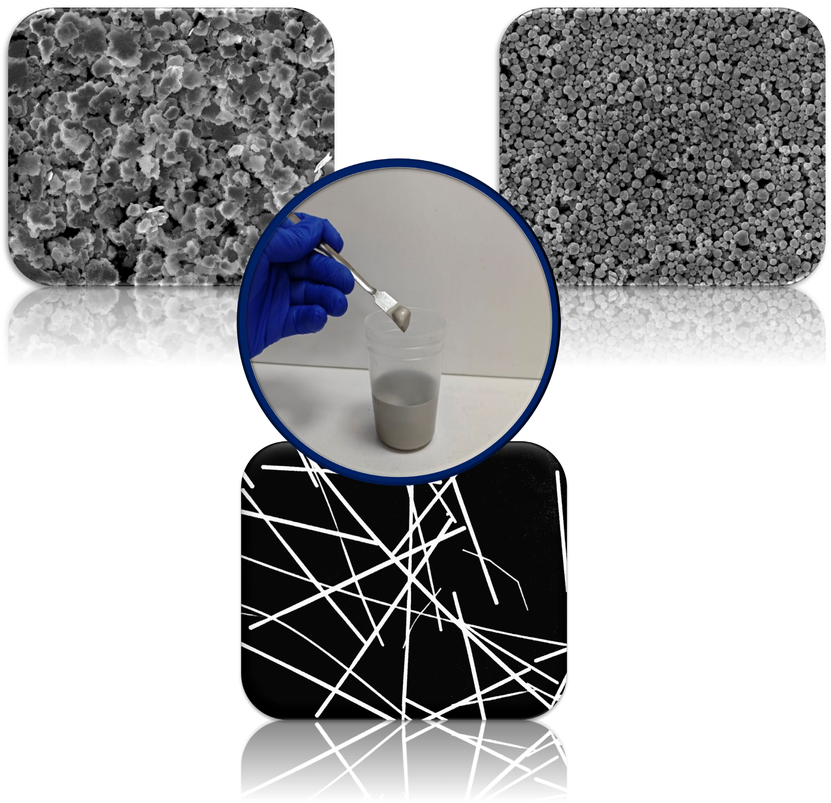
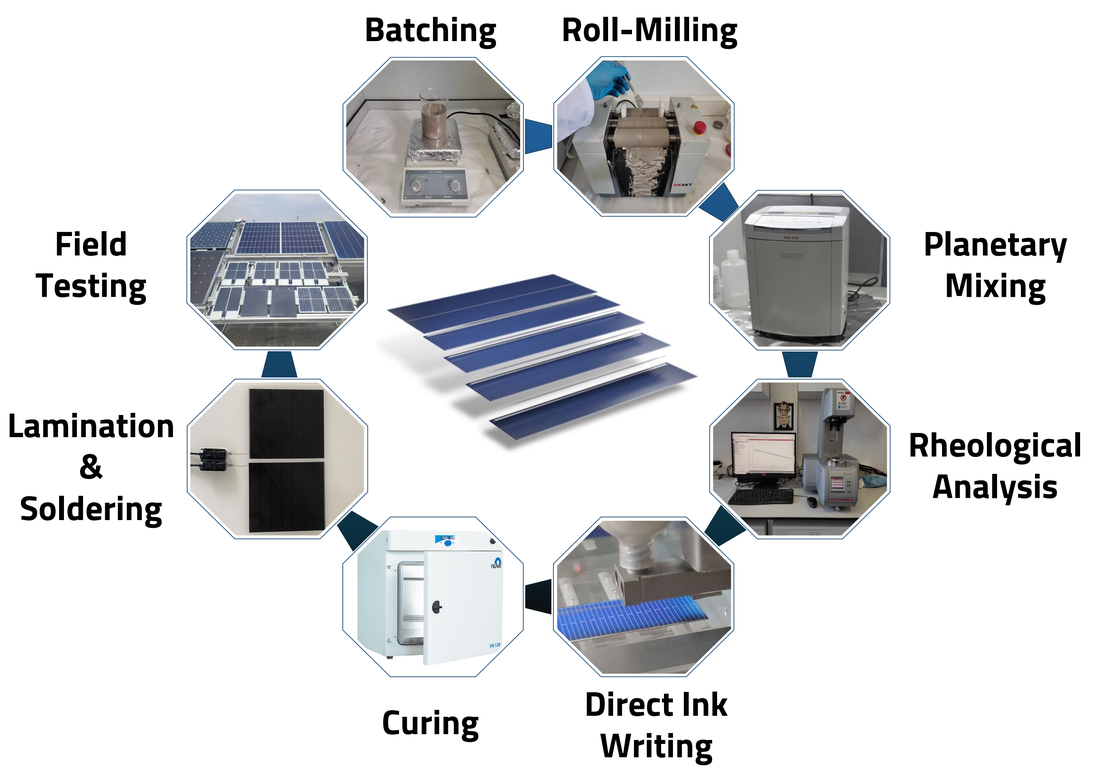
Introduction



- Electrically conductive adhesives (ECAs) are ink formulations composed of conductive fillers, solvents, dispersants, binders, adhesives and other additives. They are mainly preferred in **interconnection** of electronic components.
- In the production of ECAs, **silver flakes** are mostly preferred.
- **Silver** is favored for its **excellent electrical conductivity** and **oxidation resistance**.
- **Flakes** are favored for their **large contact area** and enhanced **percolation pathways**, improving overall connectivity and performance.
- According to market reports and literature, **toluene**[1], **dipropylene glycol monomethyl ether acetate** (DPMA)[2] and **many other solvents** are used in the production of ECAs.
- These types of solvents have **negative impacts** on the **environment** and **human health**.
- However, **no water-based electrically conductive adhesive** has yet demostrated suitability for PERC-type shingled solar cells.
- There is an urgent need to **shift towards water-based** formulations to minimize environmental effects.

Methodology



Results

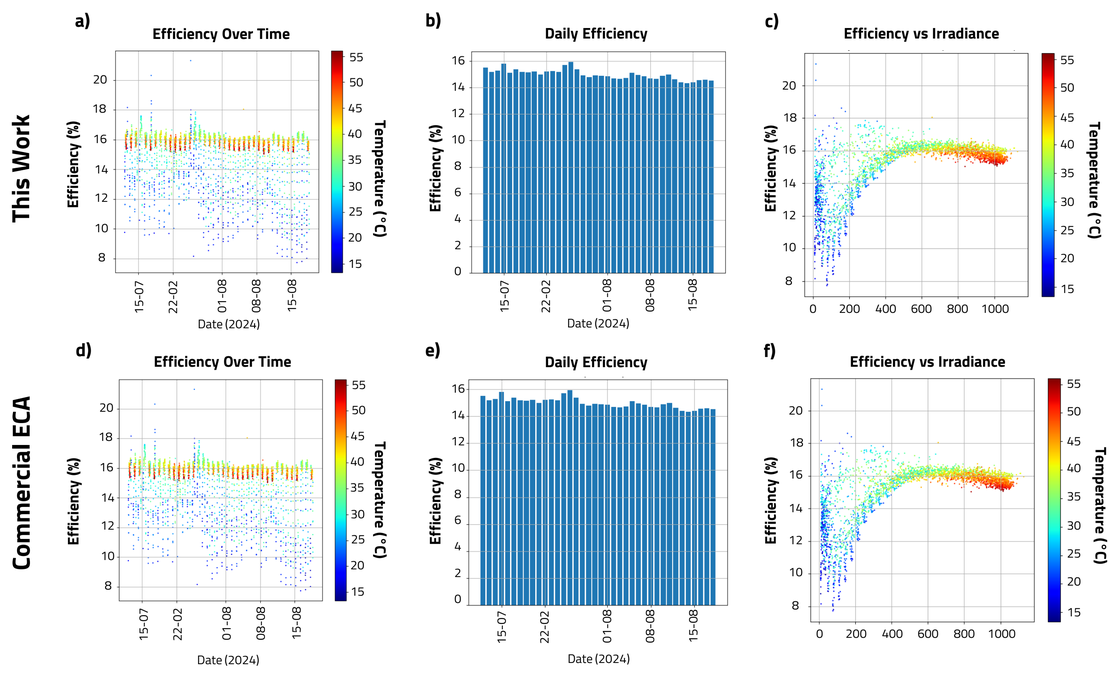
- **Rheological behaviour** of the pastes can be **modified** through changing the chemical proportions.
- Produced ECAs can be applied via **screen printing** and **direct ink writing** methods.

Electroluminescence and Field Testing of Water-Based and Commercial ECAs.

- **Sheet resistivities** as low as **8.71 mΩ/sq** have been achieved, demonstrating significant promise compared to commercially available ECA.
- Furthermore, large-scale production can be **easily scaled up** to quantities of **several tons**.
- **Sun simulator and field testing over time** have demonstrated that the ECA produced in this study showed **slightly better performance** compared to the commercial counterpart.

Module Performance

ECA	V_{oc} (V)	J_{sc} (mA/cm²)	FF (%)	Efficiency (%)	V_{mp} (V)	J_{mp} (mA/cm²)	Rs (mOhm/sq)	Res (µOhm-cm)
This Work	1.28	18.83	77.62	18.76	1.06	17.67	8.71	22
Commercial ECA	1.28	18.86	77.39	18.68	1.05	17.75	161.03	421



Efficiency results of (a) water-based ECA and (d) commerical ECA according to the temperature over time.
Daily efficiencies of (b) water-based ECA and (e) commercial ECA
Efficiency vs. Irradiance of (c) water-based ECA and (f) commercial ECA according to the temperature over time.

Conclusions

- The adhesive exhibited a volume resistivity 20 times lower than that of commercial products.
- **Field testing** of solar modules revealed that **water-based ECA performs comparably to commercial product.**
- Turkish **patent application (2024/007815)** has been filed.

References

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Acknowledgements

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