SILICON COMPOSITE ANODES FOR LITHIUM-ION BATTERIES

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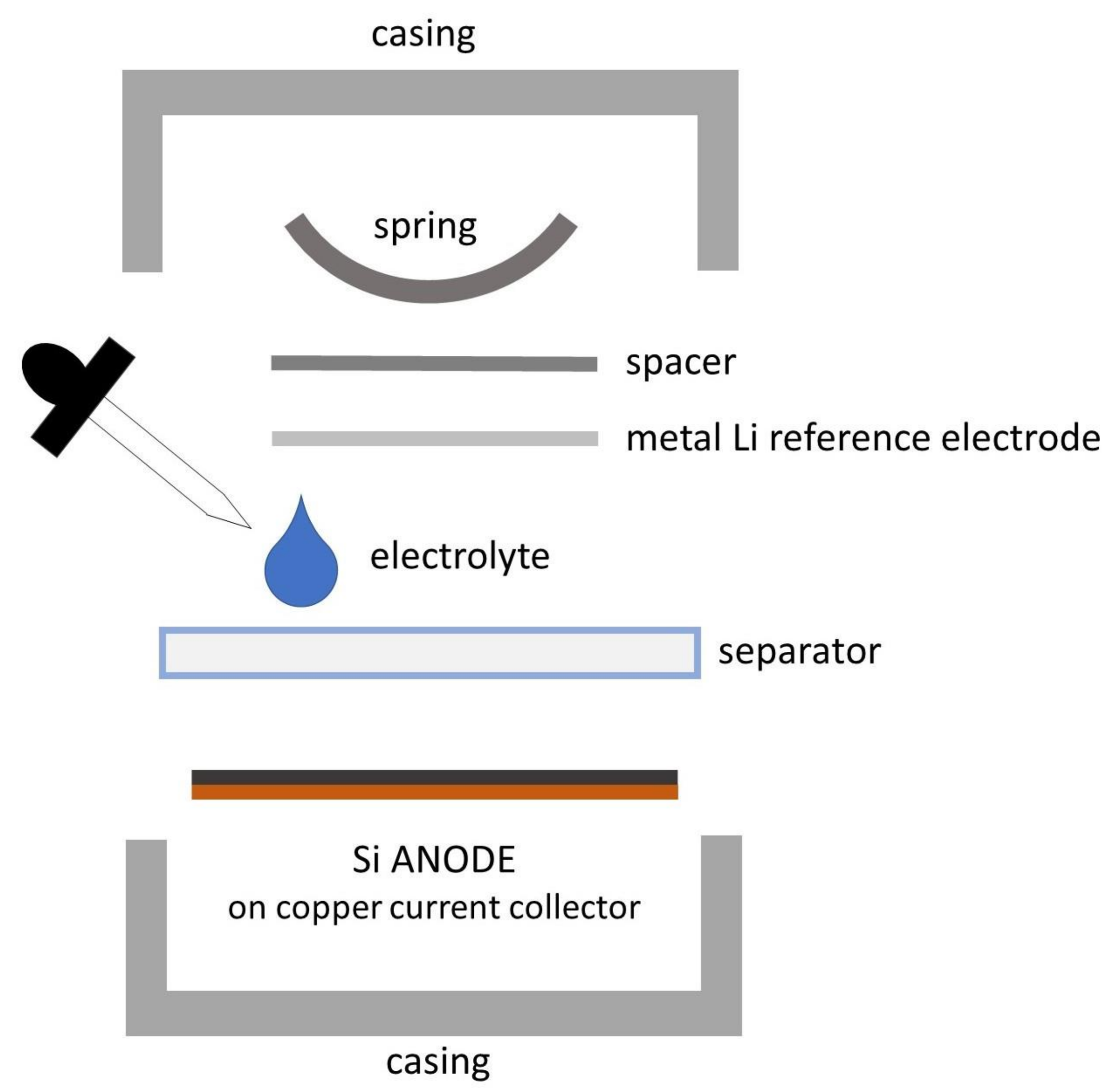
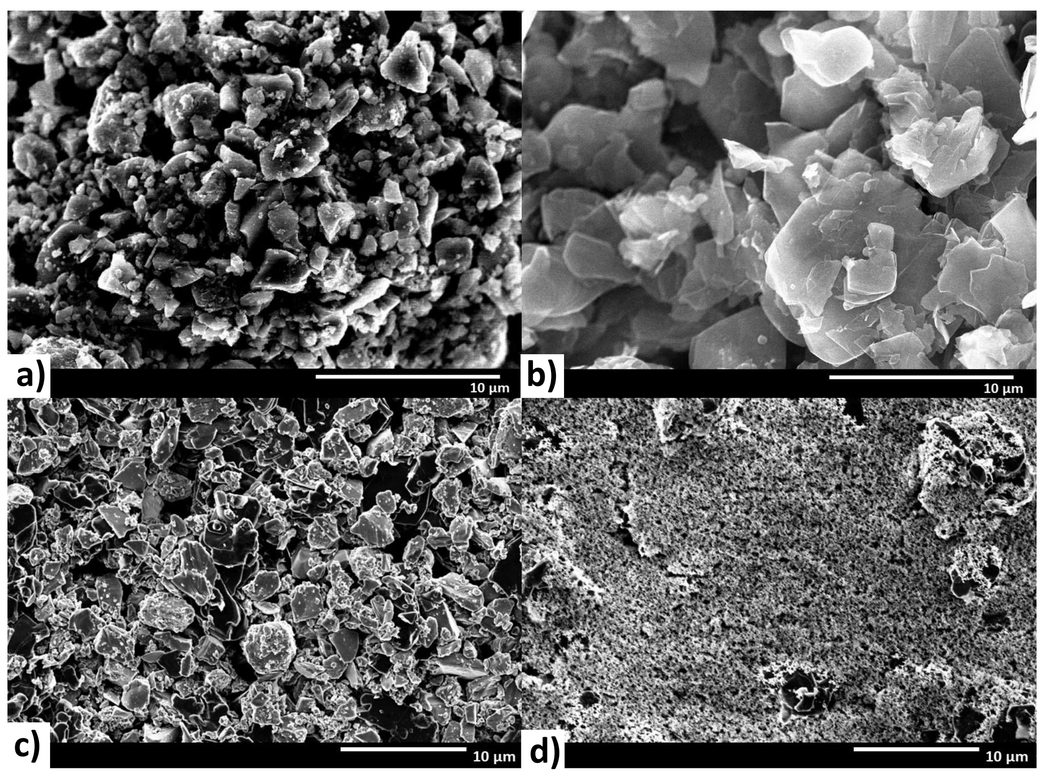
1 BACKGROUND & MOTIVATION

- Silicon is attractive as an anode material in lithium-ion batteries (LIBs) due to its **very high theoretical capacity** and **low cost** [1].
- However, **poor electrical conductivity** and **mechanical stability** lead to **short cycle lives** and **limited power densities** for the cells [1].
- The use of **silicon/graphite or silicon/graphene composites** has been reported in the literature. Carbon additives form a **conductive network** and **a mechanical scaffold** around the silicon particles [1].
- In this work, the aim was to **optimise the composition of LIB anodes based on silicon and exfoliated graphite (EG)** to improve device performances with a particular focus on rate capability.

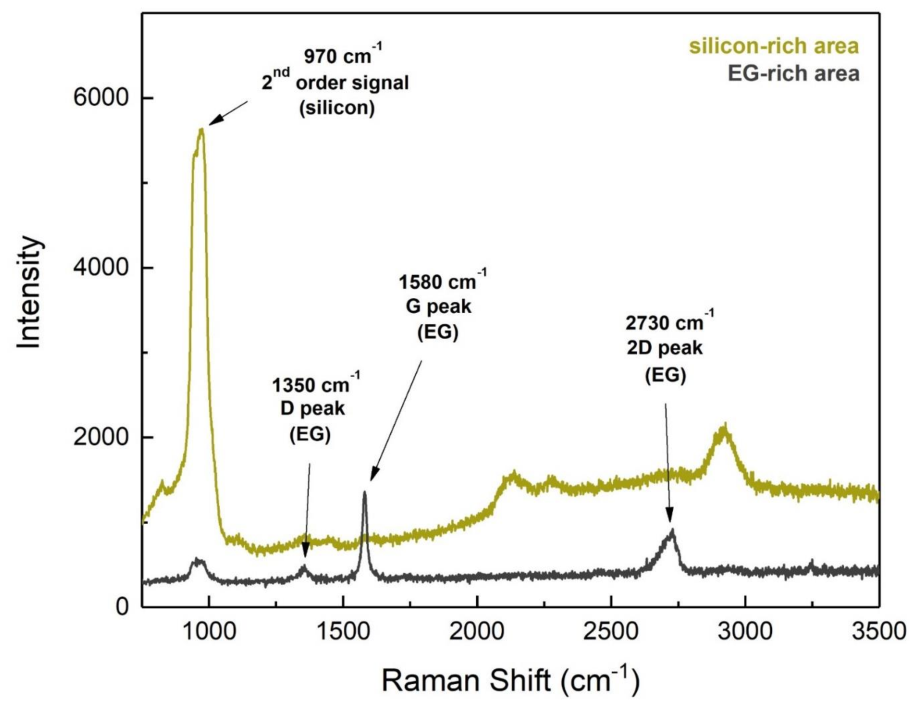
2 DEVICE STRUCTURE

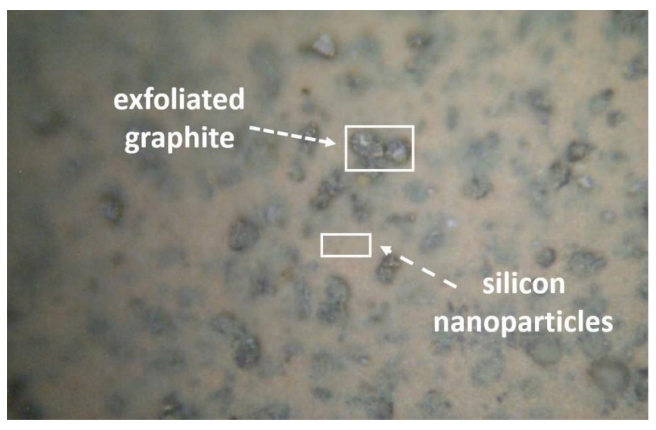


3 RESULTS & DISCUSSION



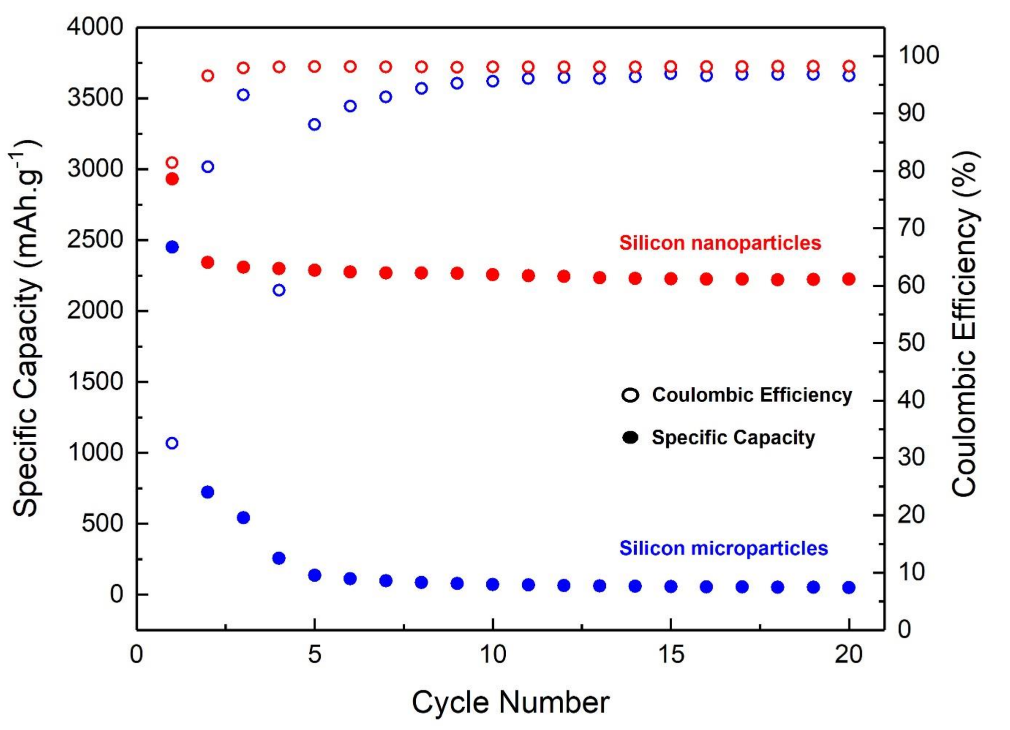
SEM pictures of :
a) silicon microparticles
b) exfoliated graphite flakes
c) silicon microparticle/EG composite anode
d) Silicon nanoparticle/EG composite anode

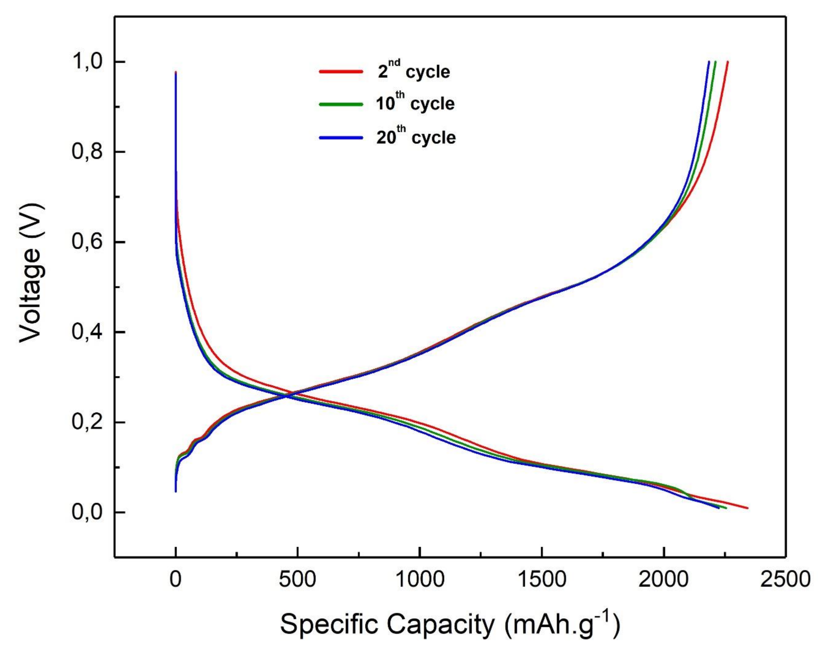




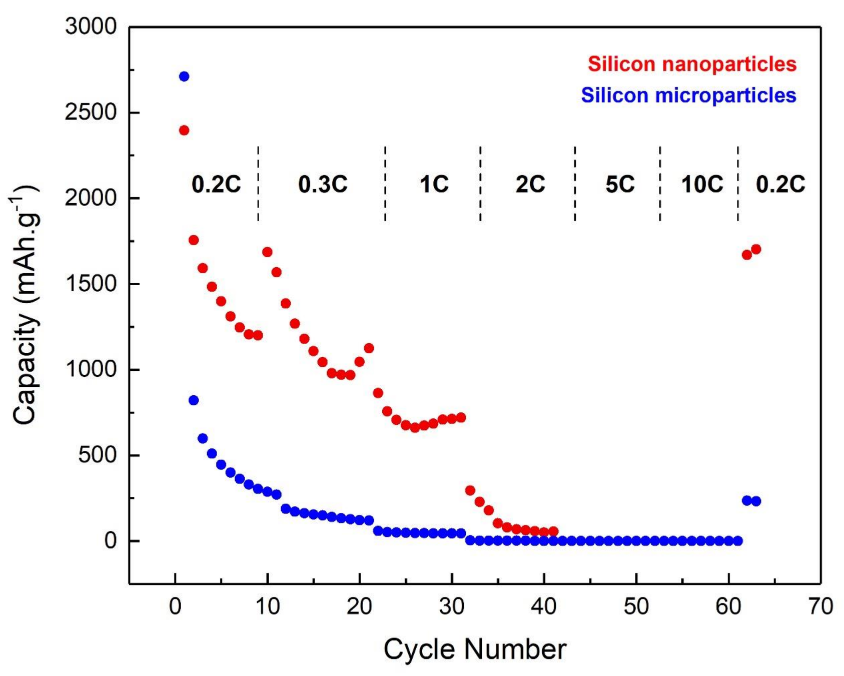
Raman spectra recorded on different areas of an anode and optical image (x50) of the corresponding electrode coating.

➔ Non-uniform coating and aggregation of EG flakes might limit device performances and lifetime.





Capacity cycle profile and coulombic efficiency for cells based on silicon nano- and microparticles (left) and charge-discharge curves for the cell based on the silicon nanoparticle anode (right).



Rate capability for cells based on silicon nano- and microparticles.

➔ The cells based on the silicon nanoparticle anode displayed higher capacity retention, longer cycle life and better rate capability.

4 FUTURE WORK

- Use of **silicon nanoparticles** ➔ for better cyclability and rate capability.
- Addition of **binders** ➔ to achieve uniform coatings and improve the mechanical stability of the anode upon cycling.
- **Chemical synthesis** ➔ to design electrodes with controlled nanostructures and prevent the aggregation of EG flakes.

Acknowledgments

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Reference

[1] Ashuri *et al.*, *Nanoscale*, **8**, 74 (2016)