Raman and SEM analysis of thin Si layers fabricated by thermal spraying of silicon powder on various substrates.

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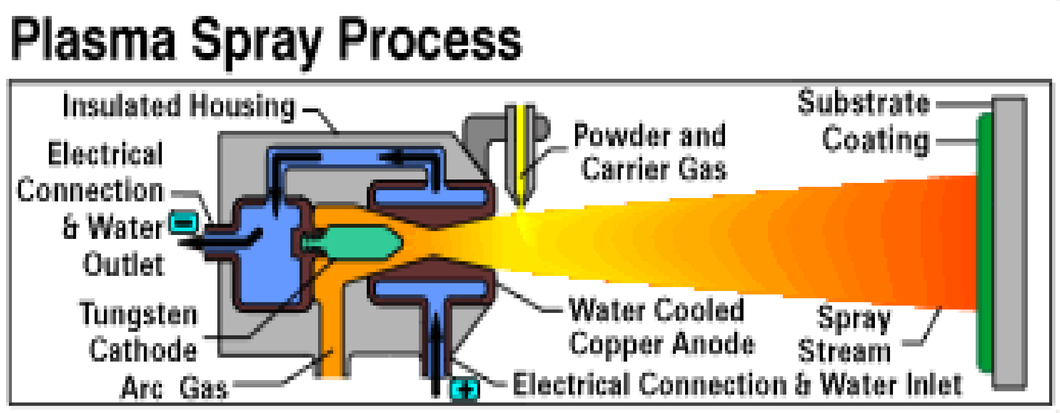
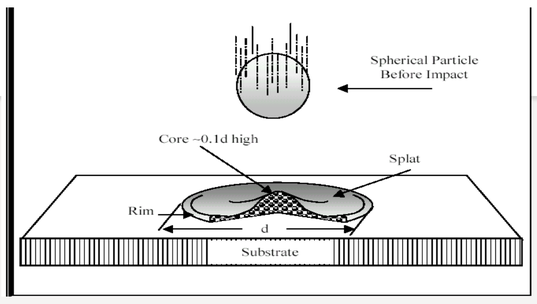
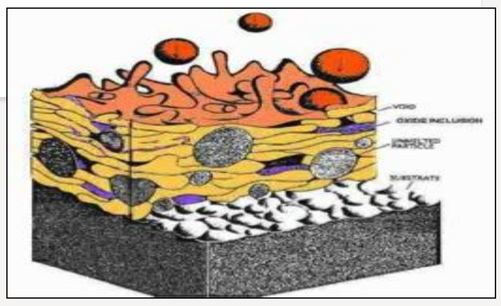
Introduction

Thin Si layers deposited on various substrates by thermal spray have been analysed by several analytical methods: SEM and Raman. The high-purity silicon particles were prepared by milling and sieving techniques and characterized for their morphology and size distribution using the direct particle measurement methods. The particles were then deposited on aluminium, ceramic and glass structures by thermal spraying technology to form a conformal and homogenous, up to 100 µm thick layer of silicon on the relevant substrates. It has been shown also, that free-standing Si powder based wafers can be fabricated using thermal spray approach. Extensive Raman spectroscopy analysis was performed on silicon structures fabricated by thermal spray before and after deposition to understand the effect of thermal cycles on the topology, homogeneity and crystallinity and state of the stresses in the material.

Experimental

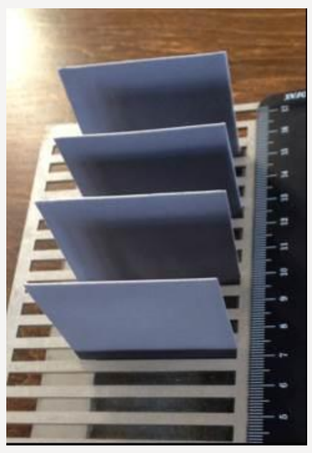


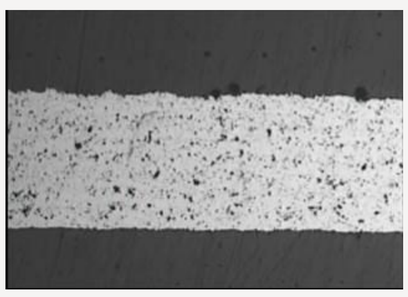




Si powder based wafers and layers

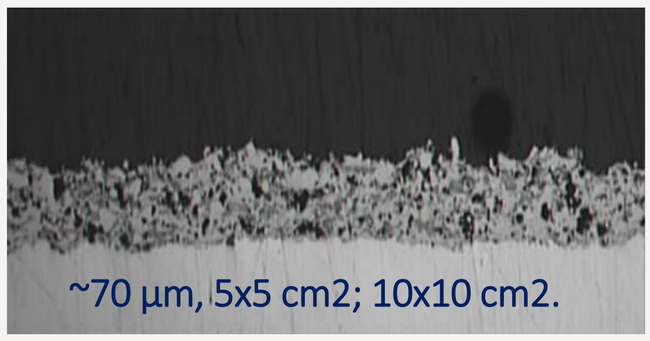
Free standing Si wafers



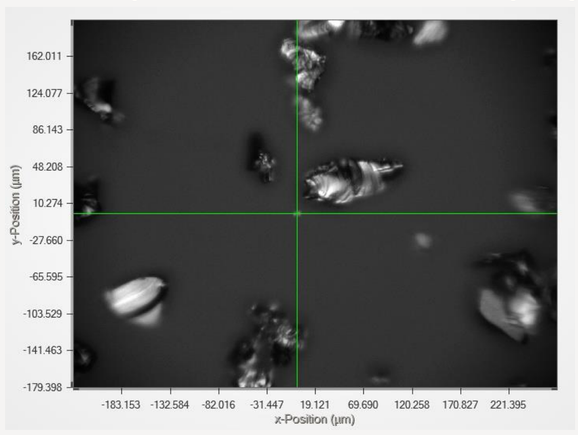


~300 µm, 5x5 cm2; 10x10 cm2.
~5 % **Al12Si**/Si mix; ~1 Ωcm

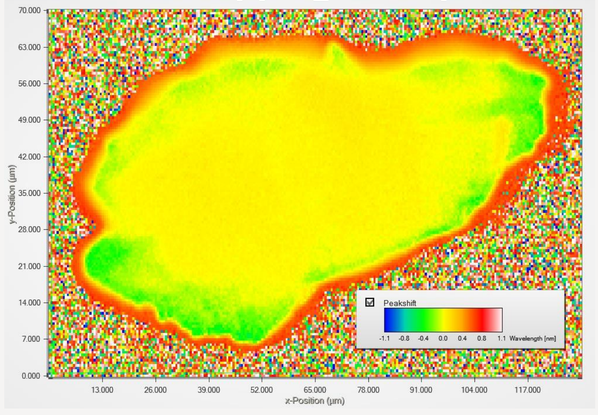
Si layers on Al substrates



Si particles for thermal spray

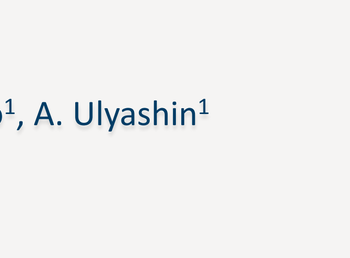


Raman mapping for Si powder



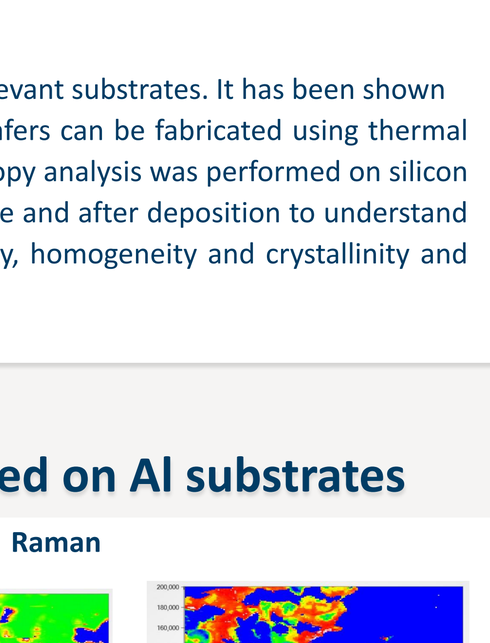
Si layers thermally sprayed on Al substrates

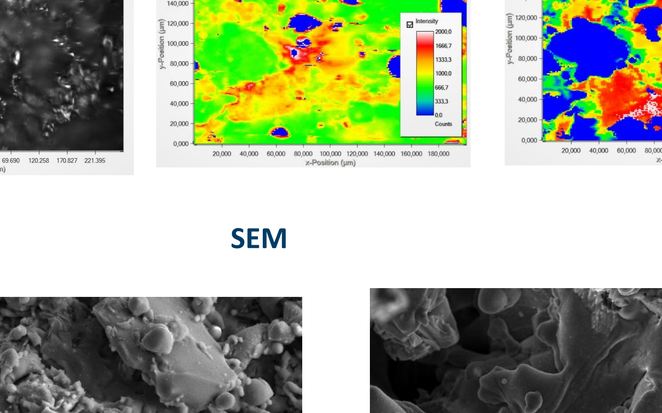
Optical microscope



Raman

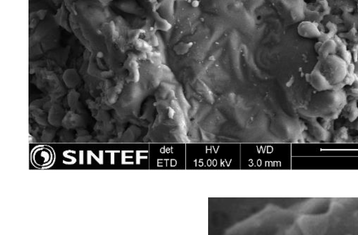
SEM



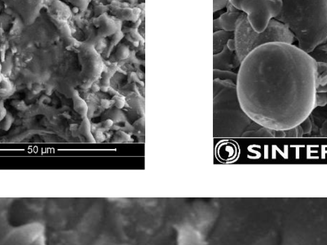


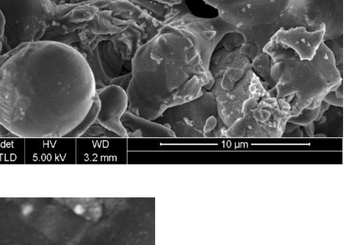
Si layers thermally sprayed on ceramics

Optical microscope



Raman





Conclusions

- It is established, that thermal spray of silicon layers can be considered as a promising method for fabrication of thin crystalline Si based layers on low-cost substrates using low-cost silicon powder as a feedstock.
- Almost fully crystalline Si layers can be deposited using non-vacuum approach
- Such layers potentially can be used for the low-cost PV.

Acknowledgements

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