

# Thermo-Mechanical Behaviour of Multi-Layered Ceramic Systems for SOFCs

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## ABSTRACT

SOFCs have to withstand considerable mechanical and thermal stresses during production and especially during operation. Mechanical failure of one cell is enough to damage the whole stack, threatening the lifetime and efficiency of the entire system. Thus, it is of high importance to gain knowledge on the mechanical properties of the cell, improving the reliability and durability of SOFC technology.

In this study, the overall behaviour of an electrolyte supported cell has been investigated. Destructive and non-destructive tests have been performed. Results show that the elastic moduli of the cell continuously decreases with the increasing number of layers.

## INTRODUCTION

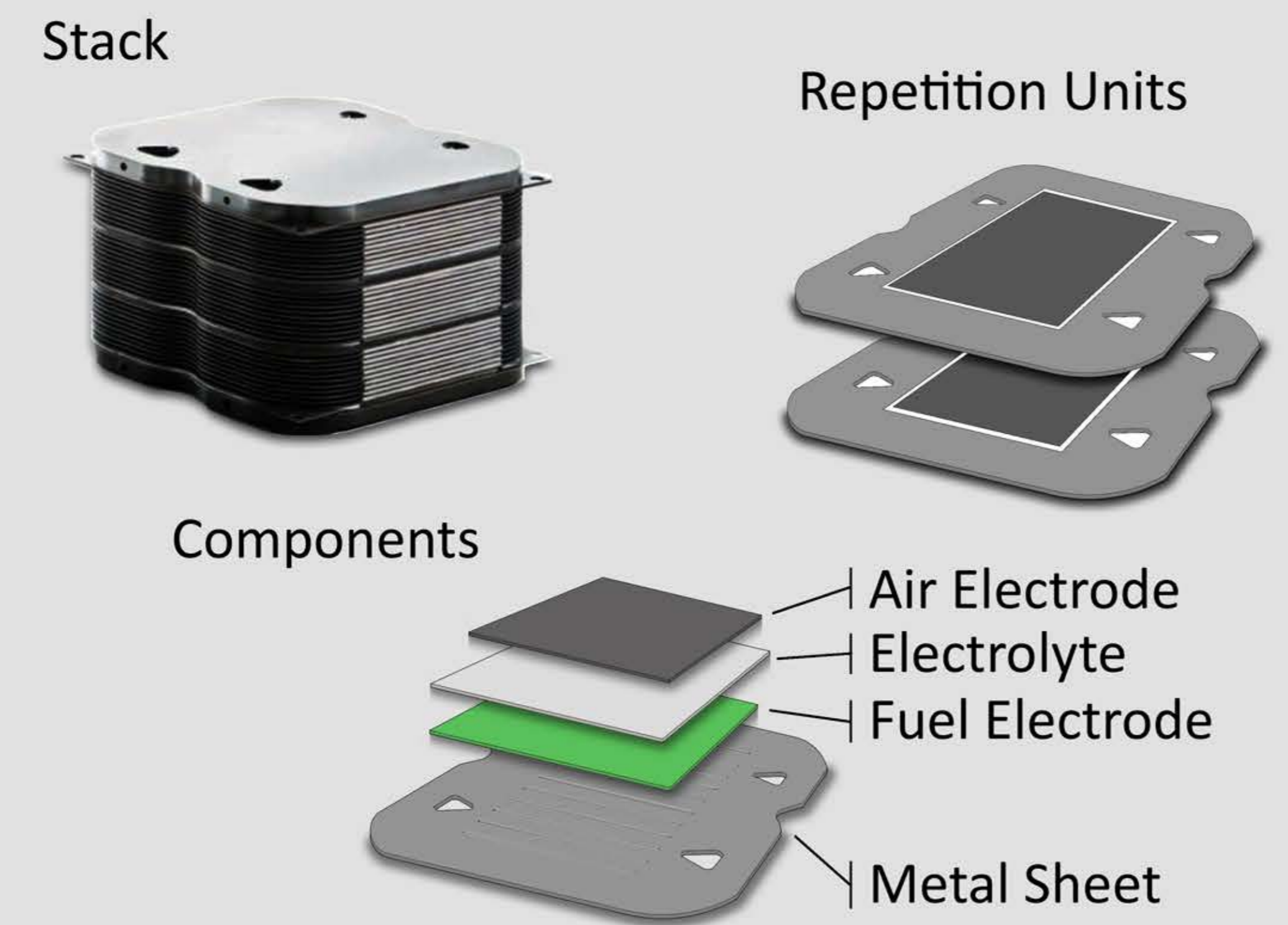
SOFCs opened a way for a necessary revolution in the power generation industry; hence, the importance of the development and improvement of these devices.

- **Focus** Layered structure of SOCs
- **Goal** Investigation of the overall elastic behaviour of the MEA

Overall properties of MEA (Membrane Electrode Assembly) are affected by constraints arising between layers, co-sintering effects and interfaces.

- **Methodology** Layers added one by one  
 Destructive and non-destructive tests  
 Comparison of the behaviour between consecutive samples  
 Laminate theory

## MATERIALS AND METHODS

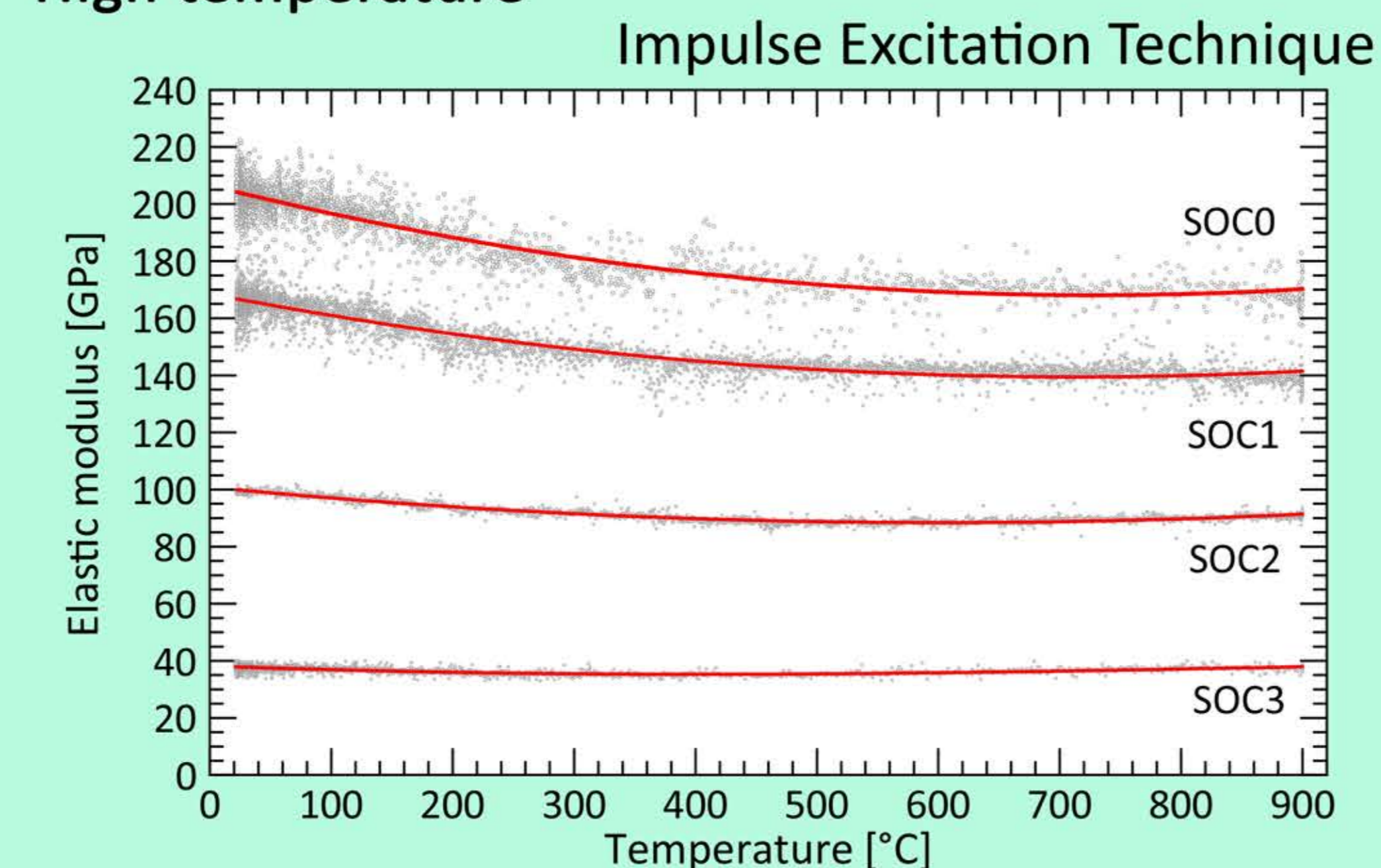


Sample	Name	Description
	SOC0	Electrolyte
	SOC1	Electrolyte + GDC Barrier
	SOC2	Electrolyte + GDC + Fuel Electrode
	SOC3	Electrolyte + GDC + Electrodes

- **Impulse Excitation Technique (IET)**  
 Device: IMCE NV, Genk, Belgium  
 Samples: Rectangular bars (13 x 5 x t) mm
- **Three-Point Bending test (3PB)**  
 Device: INSTRON 8862 Norwood, MA, USA  
 Samples: Rectangular bars (7 x t) mm, 16 mm span
- **Tensile test**  
 Device: INSTRON 8862 Norwood, MA, USA  
 Samples: Bone shaped, 50mm gauge

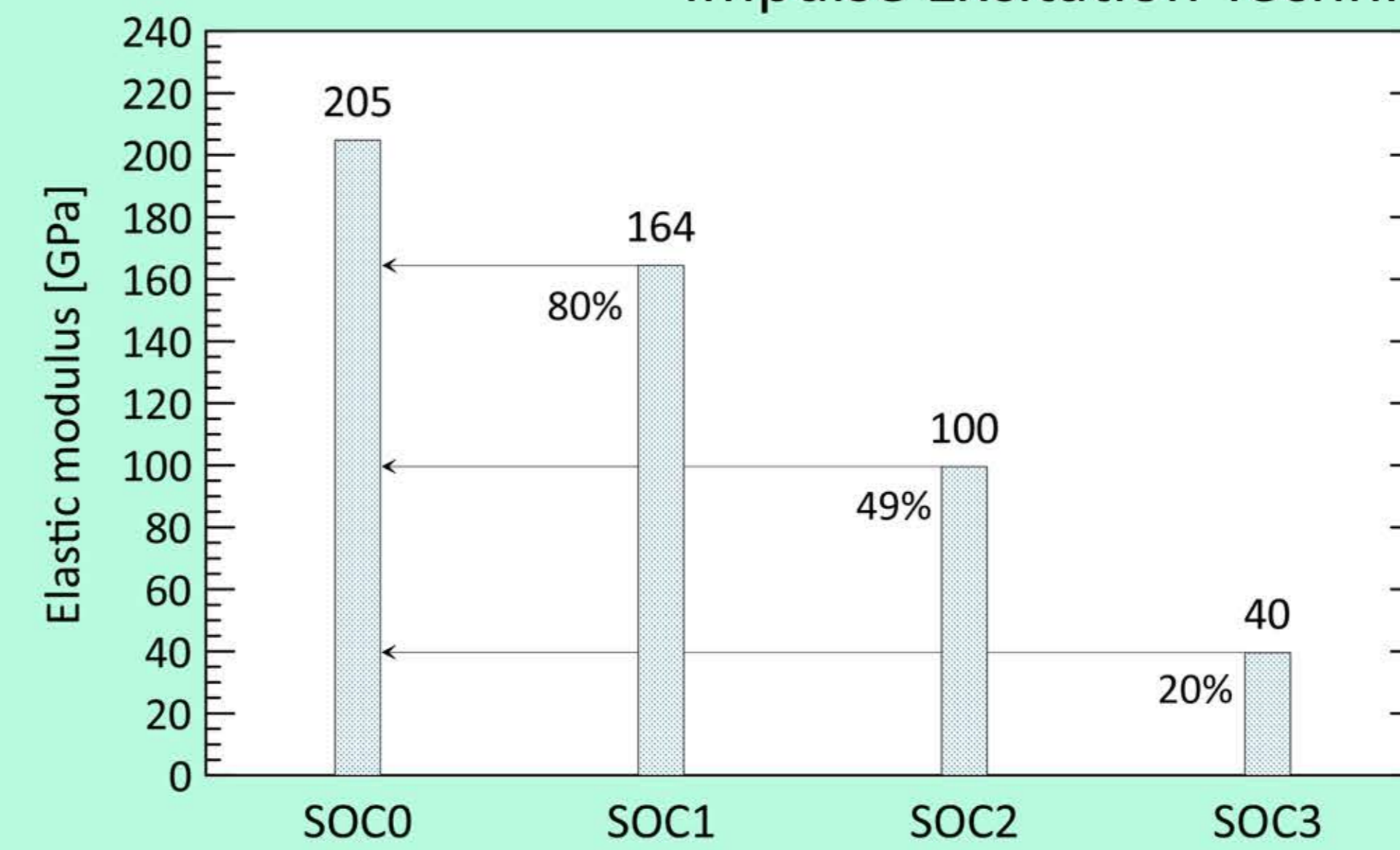
## RESULTS

### High temperature



### Room temperature

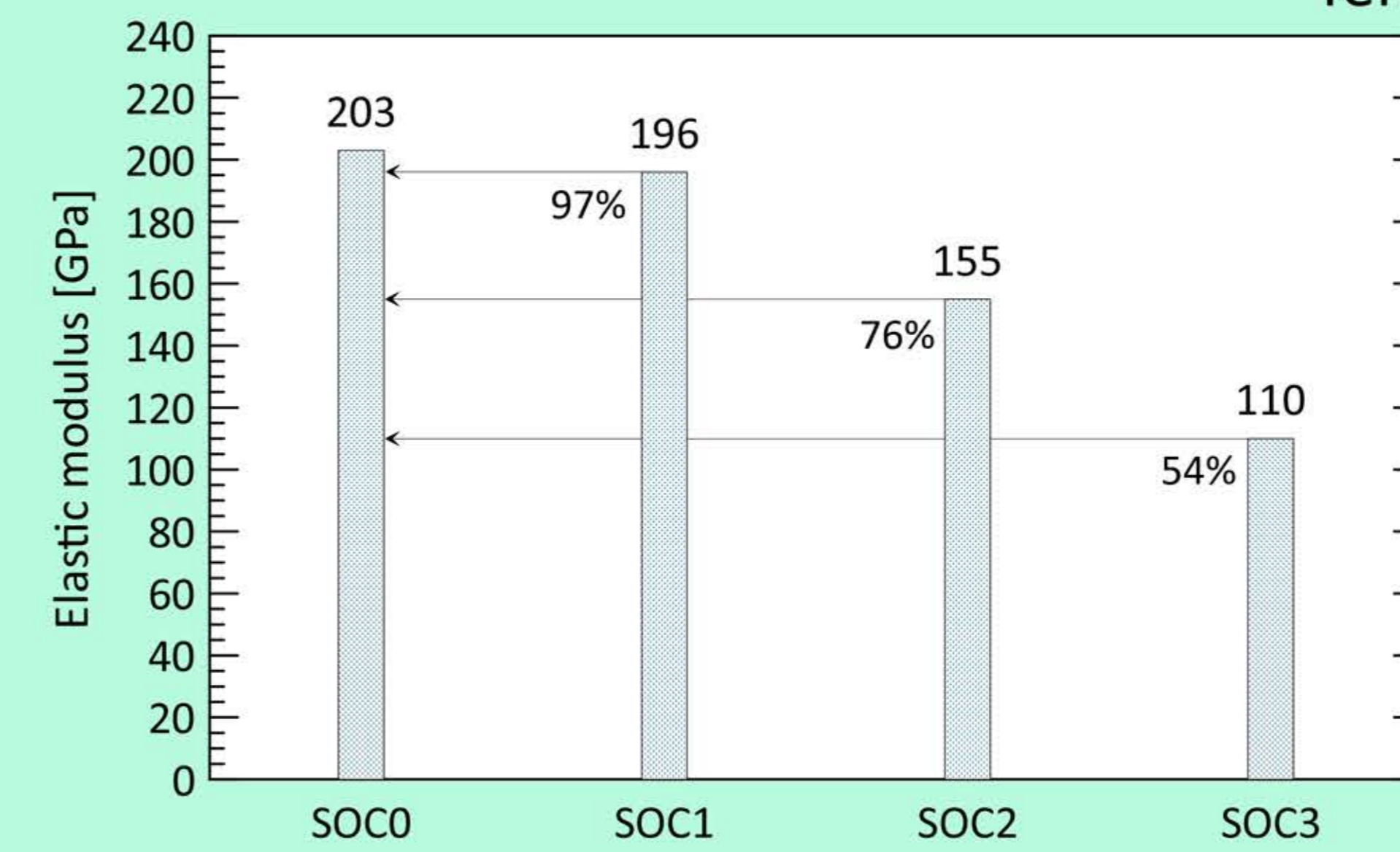
#### Impulse Excitation Technique



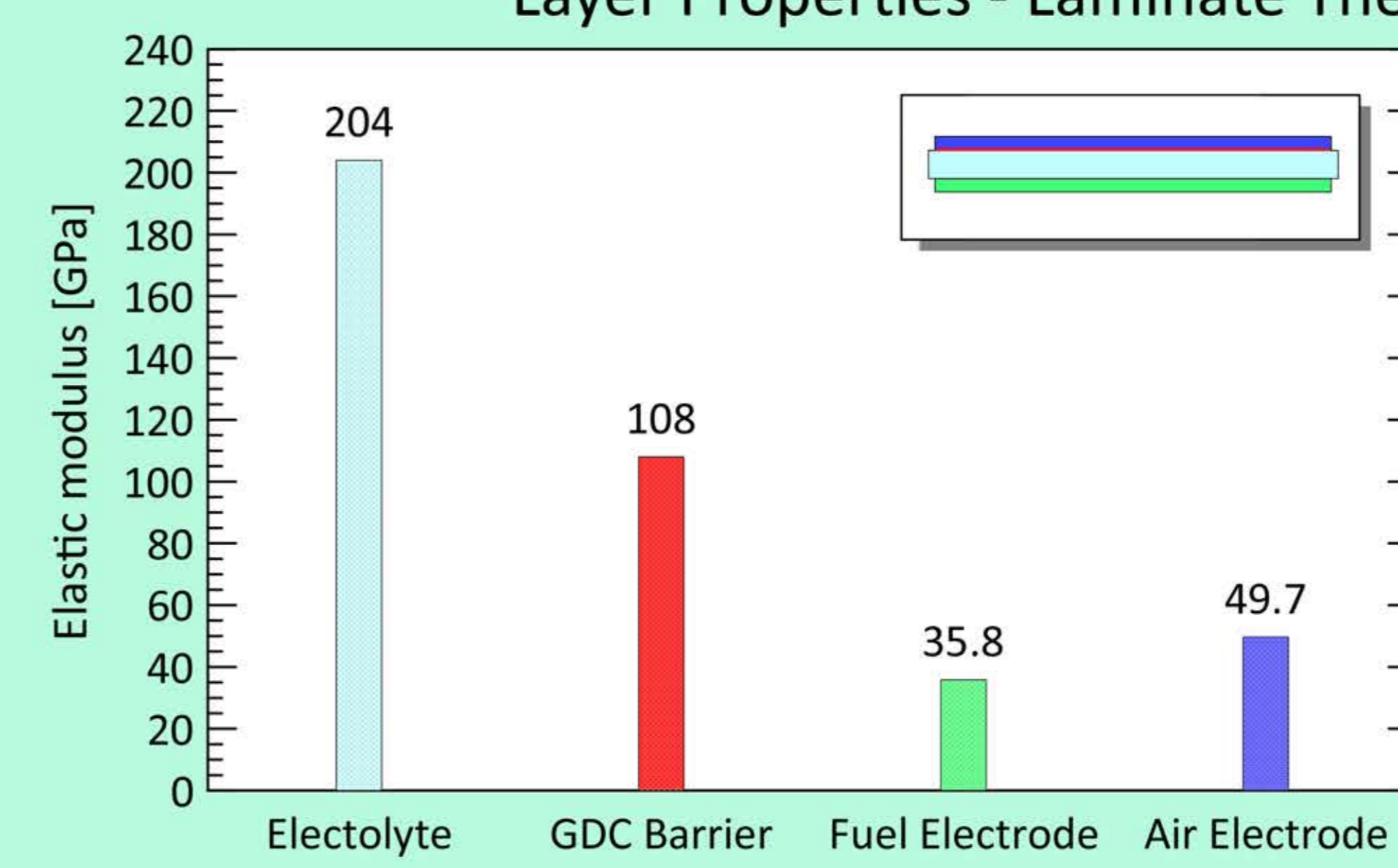
#### Three-Point Bending



#### Tensile



#### Layer Properties - Laminate Theory



## CONCLUSIONS

- Continuous decrease in Elastic modulus when adding layers to the electrolyte;
- Behaviour vs temperature getting almost constant with increasing number of layers;
- Good agreement between IET and 3PB results and between all the results for the electrolyte;
- Orthotropic behaviour of MEA observed
- Elastic Modulus of individual layers derived from tensile test results, through laminate theory principles.

## ACKNOWLEDGEMENTS

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