



# Soft4Sense

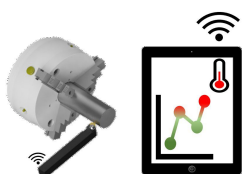
**TEandM** – Tecnologia, Engenharia e Materiais S.A (Lead Beneficiary)

**IPN** – Instituto Pedro Nunes

**INL** – International Iberian Nanotechnology Laboratory (INL)

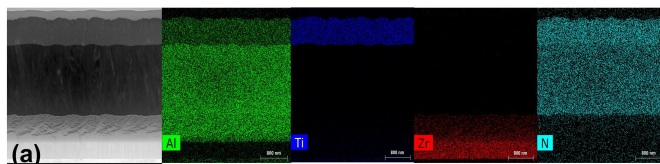
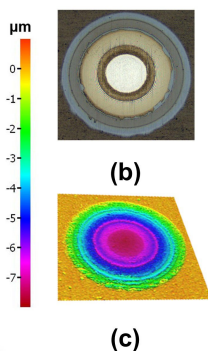
**UT Austin** – Cockrell School of Engineering and Center for Mechanics of Solids, Structures and Materials

## Smart surfaces for reliable tool integration – Motivation



The **temperature** in **metal cutting** is the most attractive parameter to monitor. **Thin-film technology** is the only way to deploy a **sensor in a cutting tool** without disturbing the process. Due to the **complexity** of the **films properties** and **deposition process** – masking, film stresses, contamination, multilayer architecture – **no market is available** for these tools. Converging **experimental work** and **simulation** is the solution to develop such **smart tools** ready for **industry 4.0** and industrial internet of **things (IoT)**.

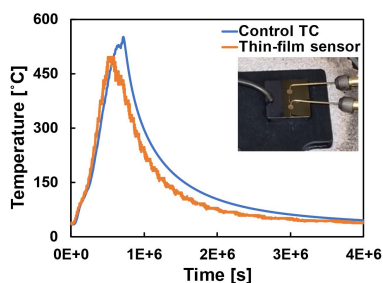
## Multilayer thin film for temperature acquisition



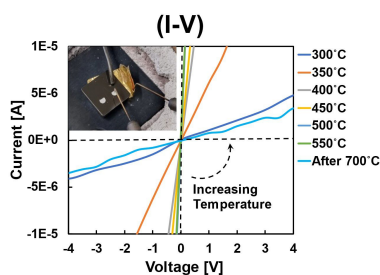
Cross section STEM image (a) Multilayer thin film deposited on WC-Co substrate. EDX Spectroscopy maps showing the elemental distribution of Al, Ti, Zr and N.

Ball crater surface image (b) and respective 3D image (c) in pseudo color displaying the layers and thickness of the multilayer stack.

## Thin-film temperature sensor



## Thin-film insulator



## Future work

- Testing the data acquisition system and the cutting tool in an actual cutting operation.
- Improve the interfacial adhesion between the different layers.
- Deep studying of the interfaces after thermal treatment – elements diffusion or contamination.
- Wear assessment of the complete multilayer system.

