

## Topic: Using Deep Learning to evaluate adhesion of PVD coatings for Industry 4.0 applications

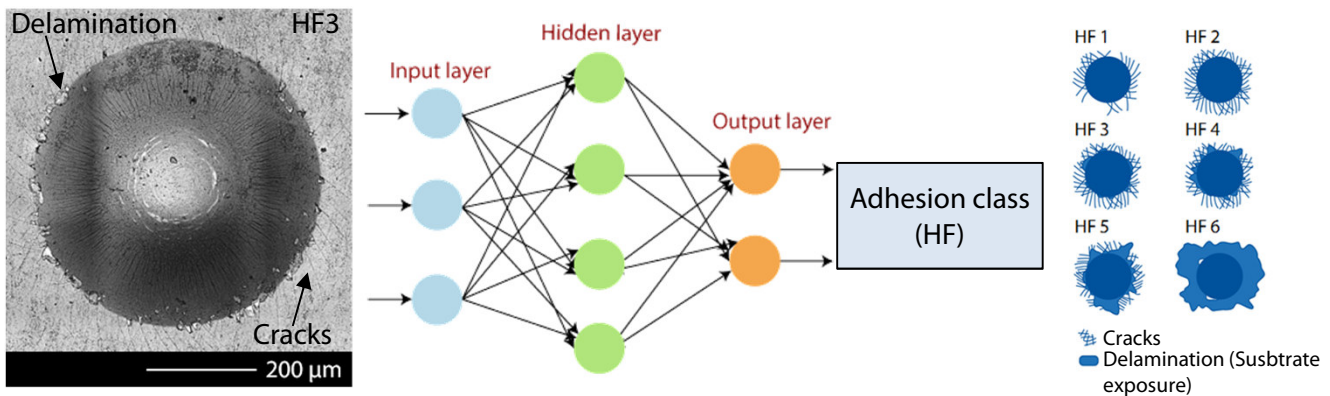
PVD-Technology (Tools)

[Angstrom Sciences]

### Topic:

**Adhesion of Physical Vapor Deposition (PVD) coatings** on substrate material is evaluated through **Rockwell Indentation Test** in which a diamond indenter penetrates the surface with certain force. Afterwards, the **images** from the indent area are manually observed for coating **cracks and delamination**. Depending on the observations, the coating is categorized into one of the **six adhesion classes** by the **human observer**. In context of **Industry 4.0**, an intelligent system to determine the **adhesion class** of PVD coatings can be developed by using **image classification and segmentation** techniques of **Deep learning**. This can eliminate the human and subjective biasness factor in strength class evaluation of PVD coatings.

Deep learning is a subfield of **Machine Learning** which uses specialized **Artificial Neural Networks (ANN)** algorithms to develop intelligent systems. Artificial neural network is an abstract model of human brain consisting of **input and output neurons** connected to each other through hidden neuron layers.



### Research Goals:

Within the scope of this work, open source **Convolutional Neural Network (CNN)** algorithms of **MATLAB and/or Python** will be used. CNN is a type of Artificial Neural Network focused on **image classification and segmentation**. The selected CNNs will be trained using images from the adhesion tests through **transfer learning method**. Finally, the **accuracy of different CNNs** will be compared with each other as well as with the current practice. **Know-how of MATLAB, Python and Deep Learning** is advantageous but not compulsory for the research work.

If you are interested, we can make an appointment to discuss further details. Kindly, contact me by E-mail or phone.

### Contact:

M. Tayyab, M. Sc.  
Tel: +49 (0)241 80-95578  
E-Mail: tayyab@iot.rwth-aachen.de

Institut für Oberflächentechnik  
RWTH Aachen University  
Kackertstraße 15  
52072 Aachen  
www.iot.rwth-aachen.de