ROBOPROX

RA5 - Automation for nanoscale surface engineering

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MINISTRY OF EDUCATION, YOUTH AND SPORTS

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Team

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RA Objective 1: Robotic magnetron sputtering

Magnetron sputtering is a very complex technique to deposit thin films. Loading/unloading of samples or parts is demanding and time-consuming work. We will use robotic arms for various operations:

- automated loading and unloading (collaboration with P. Burget, CIIRC)
- spatial deposition from small magnetron inside the deposition chamber

Deposition chamber

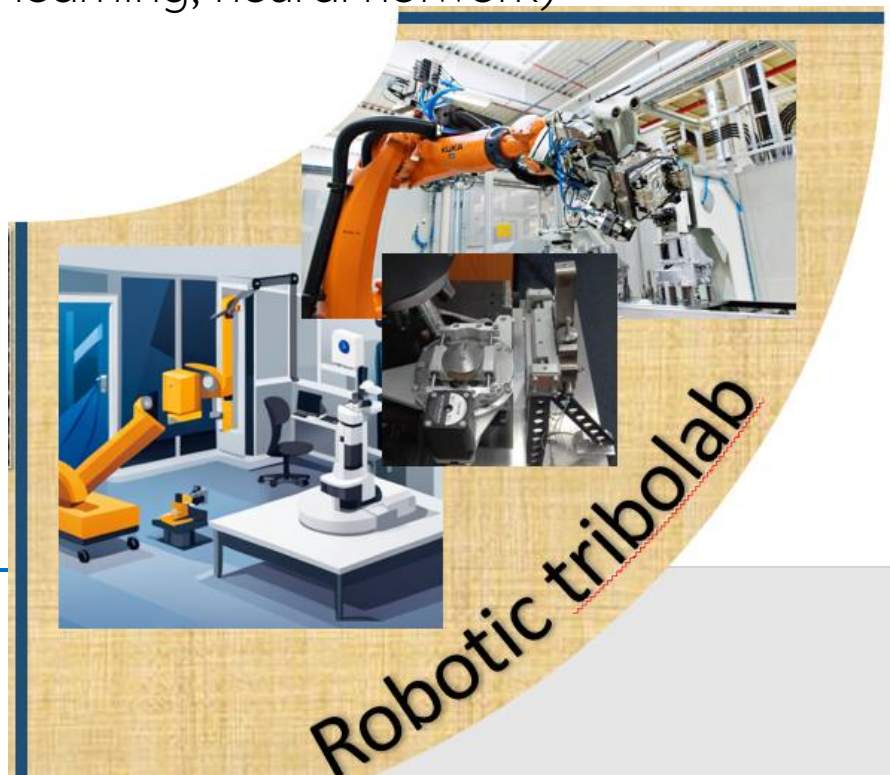
Parts to be coated

RA Objective 2: Automated nanoscale tribology

We will build semiautomated analytical lab where the sample will be loaded and unloaded by robotic arms and moved between the stations using mobile platform.

This is completely new field (at least for our group), and we have no previous publications/experience.

The automated lab will provide sufficient amount of high-fidelity experimental data for advanced post processing (machine learning, neural network)



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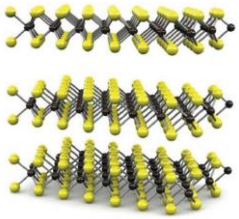
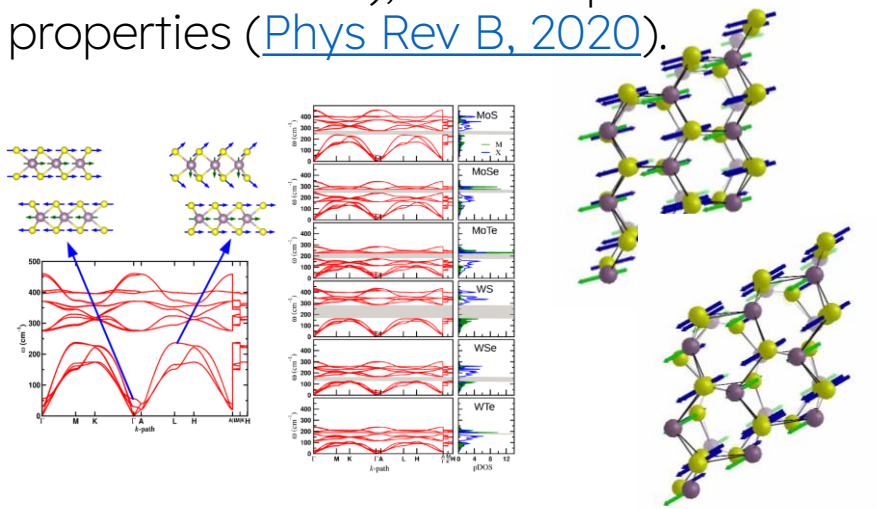
RA Objective 3: Design and manipulation of 2D materials



2D materials are extremely promising due to unique physical and chemical properties; they open new fields like spintronics or superlubricity.

Task 3.1 Design of 2D materials:

- We use atomistic simulation based on quantum physics (density functional theory) to predict new 2D materials and their combinations (so-called heterostructures), and optimize their properties (Phys Rev B, 2020).



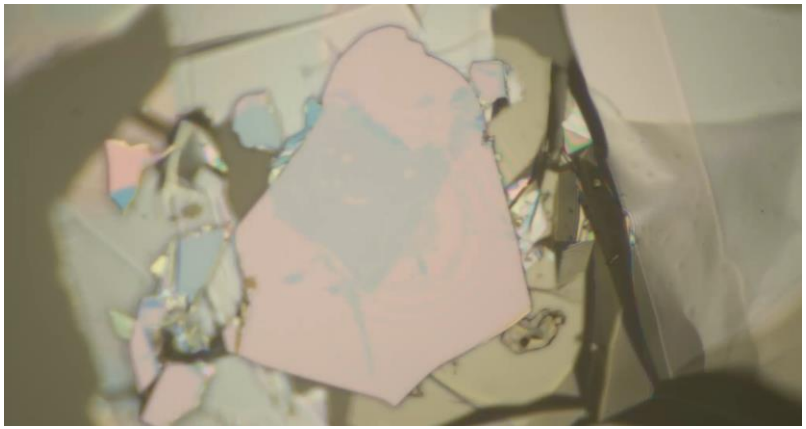
- For large scale simulations, we develop force fields (interatomic potentials) for molecular dynamics using machine learning. We will apply these potentials to analyze 2D materials sliding (Nature Materials, 2022)

RA Objective 3: Design and manipulation of 2D materials

2D materials are extremely promising due to unique physical and chemical properties; they open new fields like spintronics or superlubricity.

Task 3.2 Manipulation of 2D materials

We developed a technique to manipulate 2D materials, namely transfer them in a control way from one substrate to another (Nature Comm, 2020). It is a manual process – our ambition is full automation and connection with other devices (Raman spectroscopy, tribometers).



Sliding of graphene placed on Si wafer vs. ball wrapped with graphene sheets

Collaborations

Existing:

Thilo Glatzel & Ernst Meyer, University of Basel (2D materials – experiments)

Planned withing Roboprox:

RA4, RA2

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Thank you for your attention!

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