

Advanced tool materials and their influence on the parameters of CNC machining of wood-based materials (PART I)

Lud'ka Hanincová, Jiří Procházka, Petr Rokoský

GOAL OF THE PROJECT

- 1) The goal of the project is to quantify machining parameters of tools designed for CNC machining of commonly used wood-based materials.
- 2) To analyze the machining process focusing on the cutting forces and energy consumption and to create a methodology for choosing the appropriate tool coating and cutting conditions depending on the machined material.

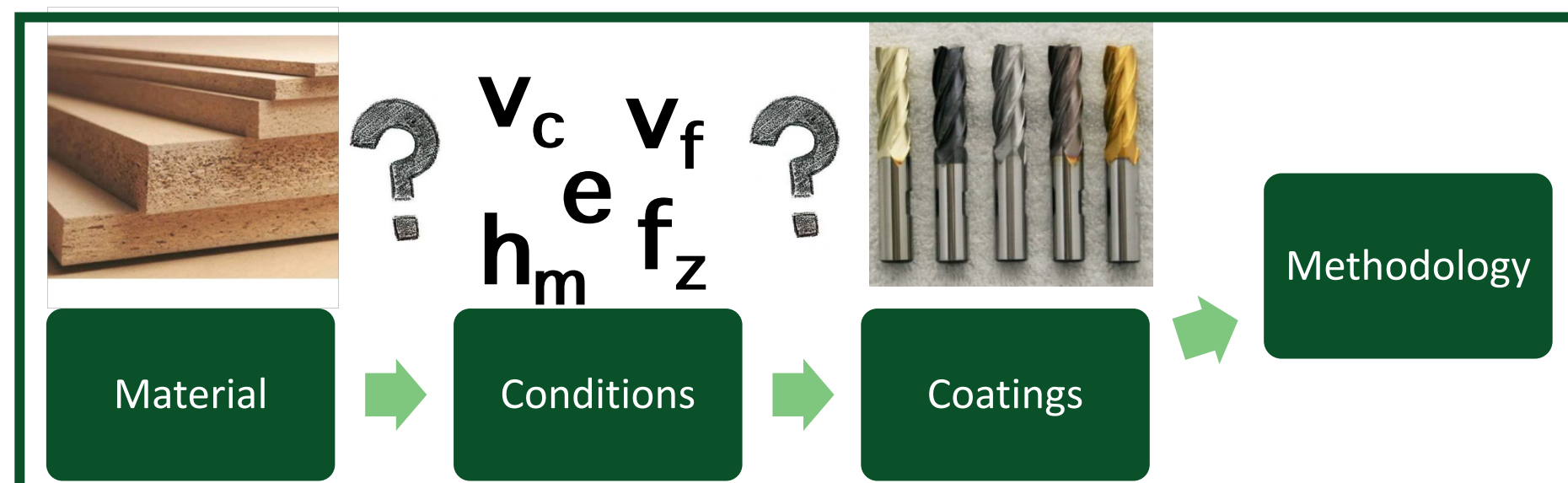


Fig. 1 Basic scheme of project

ANNOTATION AND HYPOTHESIS

Wood-based materials have a low thermal conductivity, therefore the heat generated during machining is concentrated in the cutting tool. In the surface layers of the tool, the temperature while wood is being machined can be up to 850 °C.

A common solution to reduce the coefficient of friction is to apply a suitable tool coating, which has a positive effect on both the friction of the tool against the material and the easier chip evacuation from the cut.

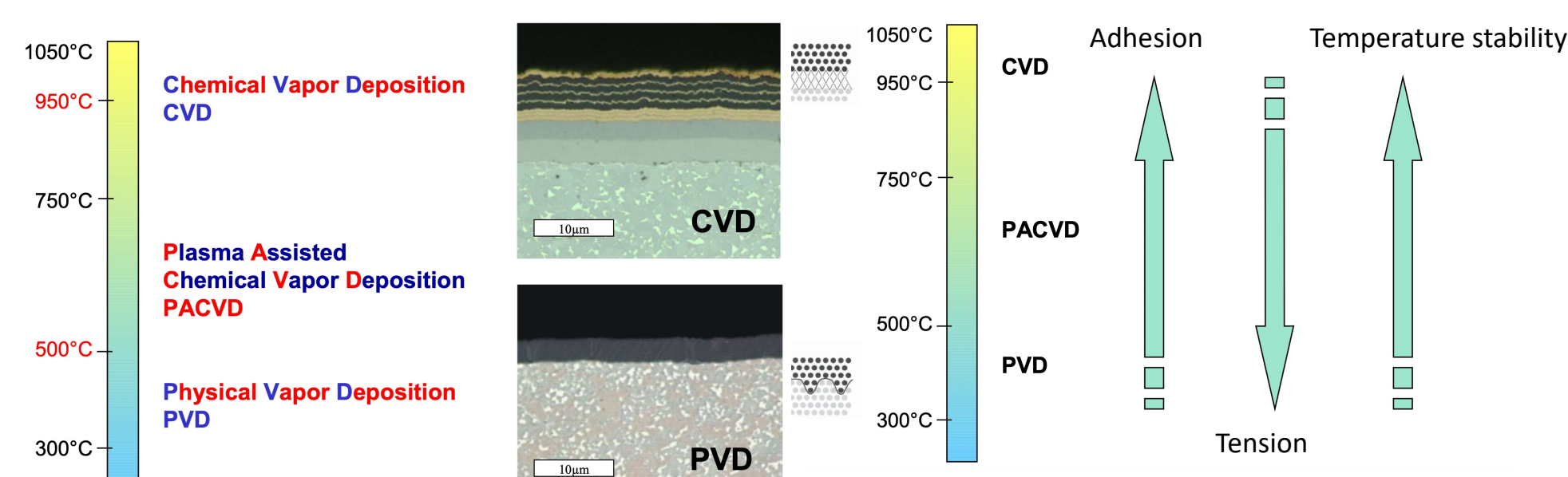


Fig. 2 Basic deposition principles CVD; PACVD; PVD

Two basic methods, i.e. the chemical deposition (CVD) and newer physical deposition (PVD).

CVD and PVD coating are also often used methods to deposit a thin layer of carbon in its hardest sp^3 structure, so called Diamond-like Carbon (DLC).

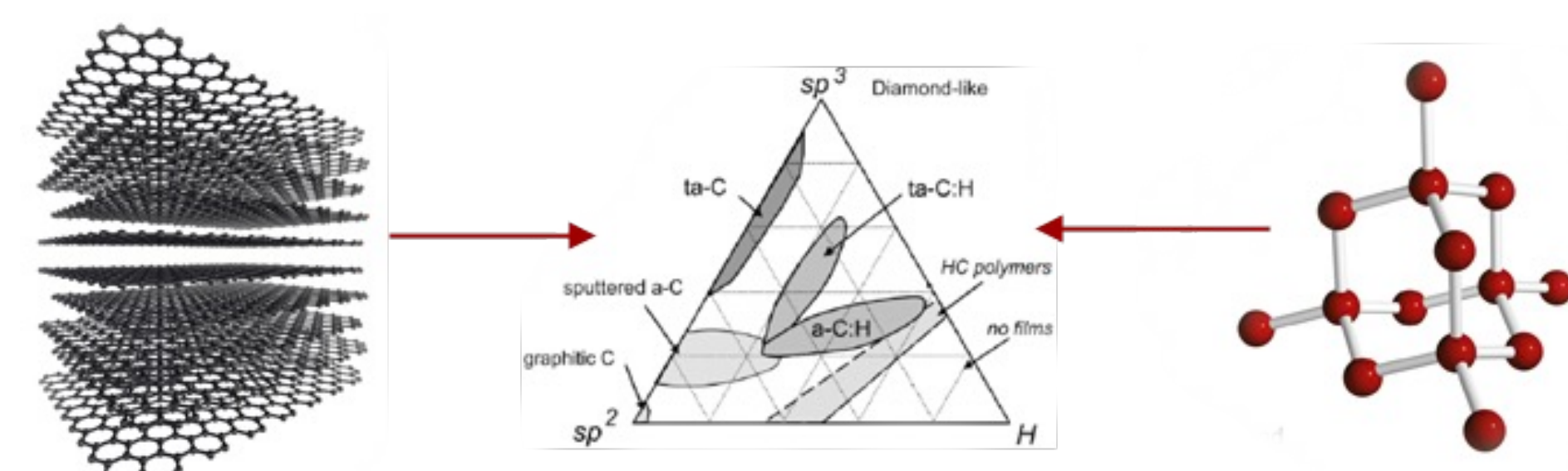


Fig. 3 Diamond-like Carbon (DLC)

For example, DLC coatings, due to their properties, appear to be a possible universal solution for machining wood-based materials, including native wood. However, it is necessary to prove this hypothesis by comparing the cutting parameters of different tool materials on different machined materials.

MATERIAL AND METHODS

The project is divided into three phases:

- 1) Measurement of energy consumption during machining
- 2) Evaluation the machined surface quality
- 3) Creating a simple methodology how to select an appropriate tool coating and cutting parameters according to machined material

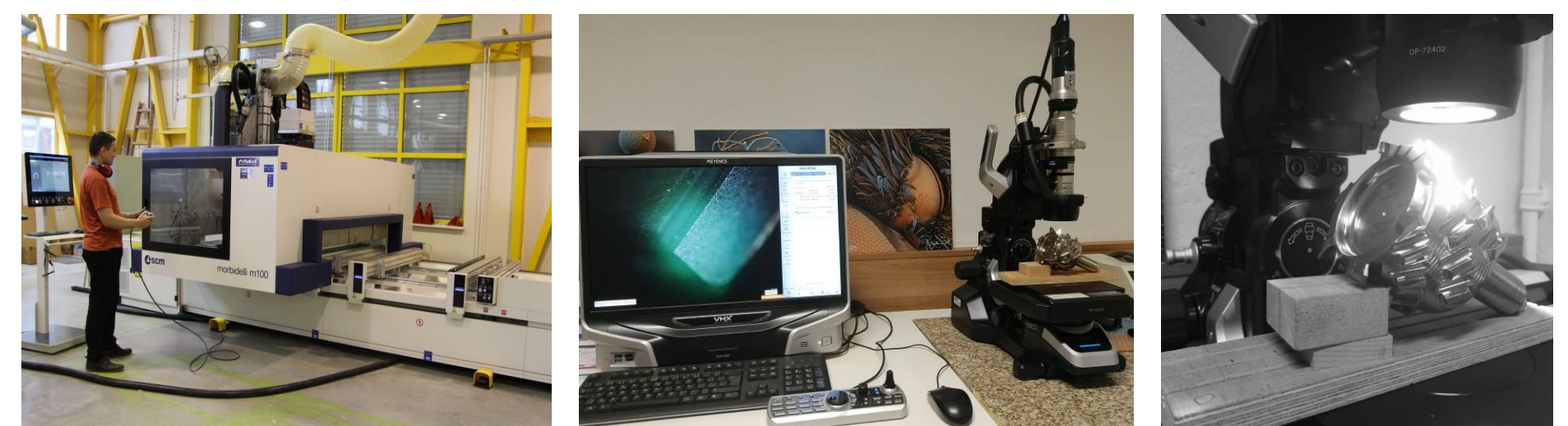


Fig. 4 Measurement of cutting forces on CNC machine; Evaluation the machined surface quality; Measurement of tool blunting

Representatives of the most used wood-based materials were selected. For the experiment, standard types of tools (Vydon s.r.o.) will be used (monolithic end mill and spiral end mill) with different modification of tool materials and coatings. CNC milling will take place on a standard Morbidelli m100 CNC machine.



Fig. 5 measurement equipment; Tools with different type of coatings

During the experiment, the cutting parameters will be methodically changed: feed per tooth (chip thickness) and depth of cut for both conventional and climb milling. The values of the forces acting on the workpiece and the tool will be measured and compared with the theoretical calculation. In the further phases of the project, the quality of the machined surface will be evaluated for the given machining conditions and the materials used.

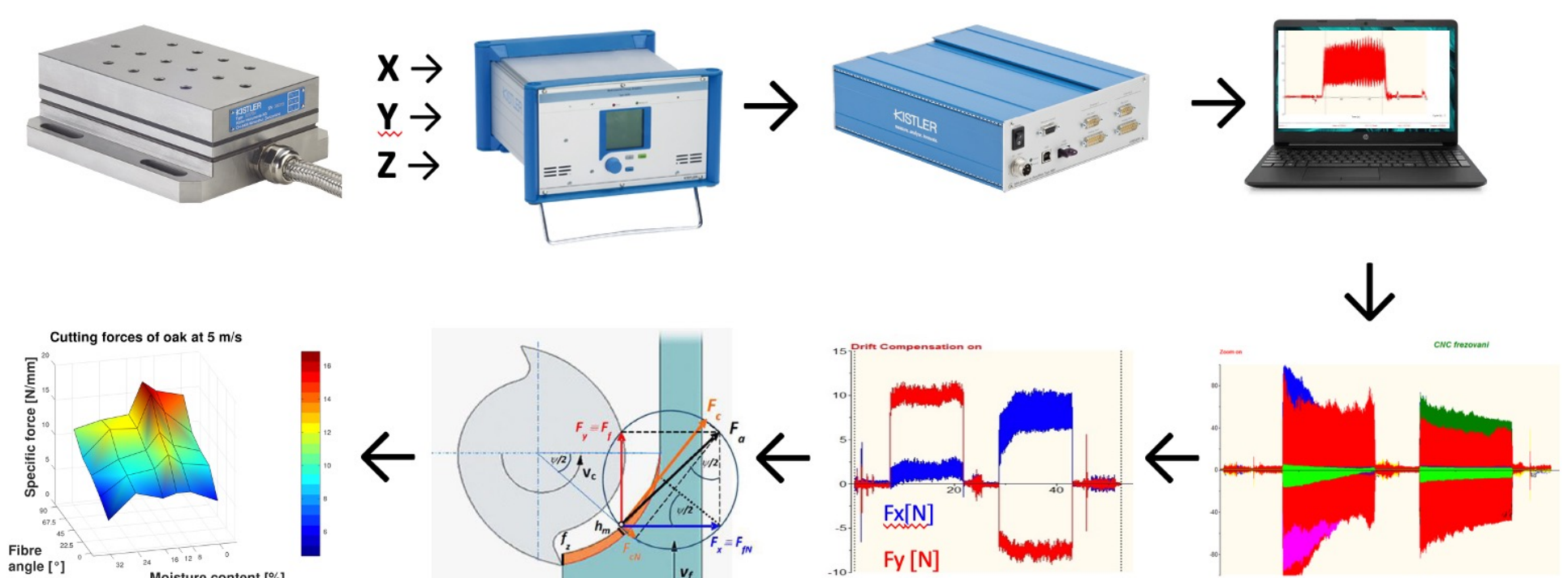


Fig. 6 Measurement and calculation of cutting forces

CONCLUSION

In addition to scientific value, the results of this research can have a significant impact on practical application, where they can help in choosing the right tool for machining different wood-based materials.