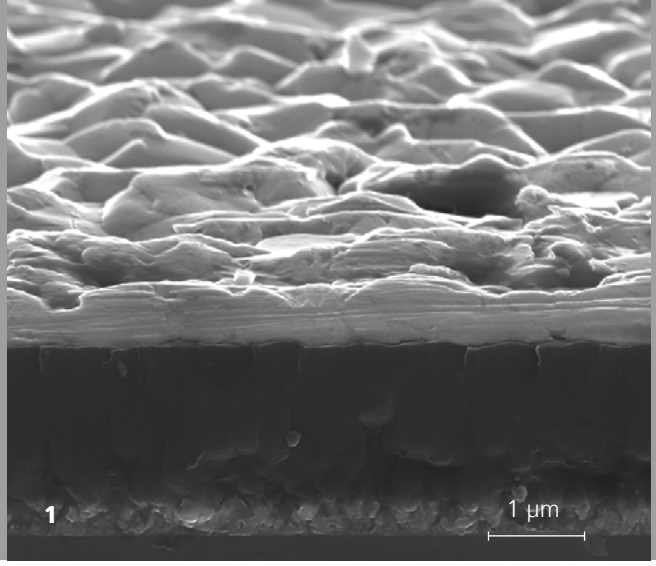


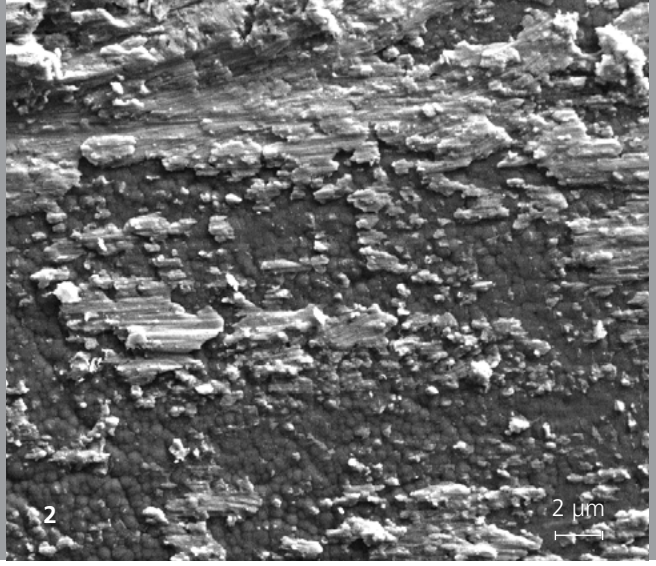


# PATH TO DRY FORMING OF ALUMINUM ALLOYS

Mastering lubricant-free forming processes represents a contribution to the establishment of ecologically and economically more efficient production technologies. Dispensing with lubricants reduces for example, operating resource costs, makes expensive systems for lubricant application and component cleaning redundant while reducing production times. As one of the world's leading institutions in the research field of carbon-based thin films, the Fraunhofer IST develops coating systems which make dry forming processes possible for aluminum alloys.

**Current challenges in aluminum forming**

Due to their outstanding weight/strength ratio, aluminum alloys are particularly suitable for the production of the weight-optimized components which are currently in demand especially in the automotive and aerospace sector and in general mechanical engineering. In comparison with conventional tool materials, aluminum's marked tendency to adhere does however place high demands on forming technologies. At present a large quantity of lubricant is still required if rapid tool wear is to be avoided in aluminum forming. This results in a considerable drop in the cost-effectiveness and sustainability of the production process.

**Coating development**

As part of the priority program SPP1676 of the German Research Foundation (DFG) the Fraunhofer IST develops anti-adhesive tool coatings to enable the lubricant-free forming of aluminum. Amorphous carbon coatings (a-C:H) show a high tribological suitability for lubricant-free sliding contacts against aluminum. However, deposited as a tool coating, current a-C:H coating systems do not allow the dry forming of aluminum alloys. One obstacle is the run-in behavior of these coatings which is characterized by a high adhesion tendency and friction. In forming processes this behavior leads to the immediate appearance of adhesions and, associated with this, tool failure before the running-in phase is overcome. In order to optimize the running-in behavior the Fraunhofer IST is developing running-in layers for a-C:H tool coatings (see Figure 1). As can be seen in the diagram and also in Figures 2 and 3, application-related tribometer tests reveal a significant reduction of the adhesion tendency and friction. This illustrates the great prospects of success in achieving dry forming processes by using the a-C:H coating system which has been developed.


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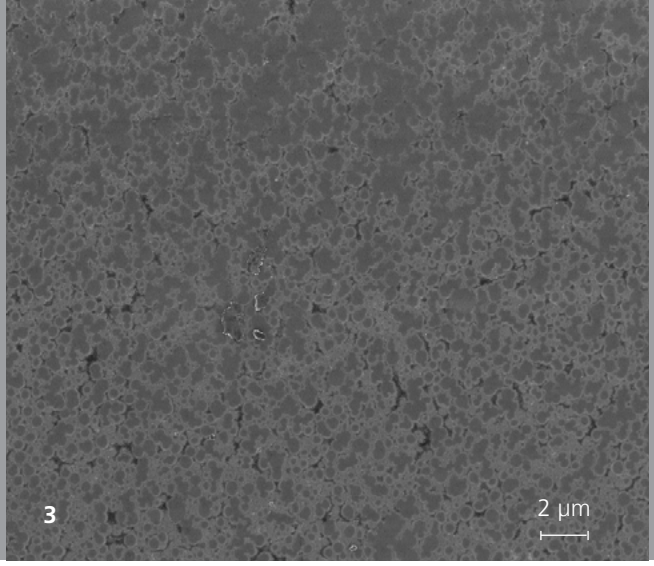



1 *SEM cross-sectional image of an a-C:H tool coating with run-in layer.*

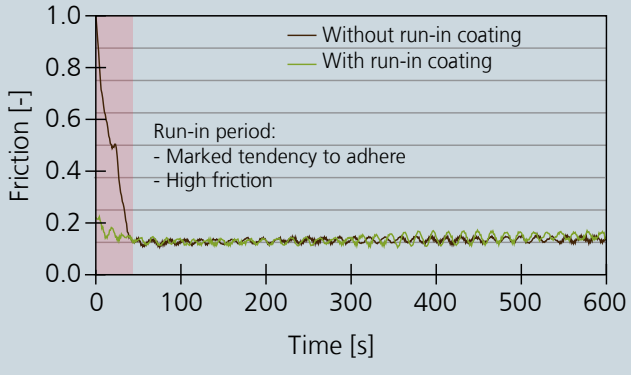
2 *Aluminum adhesions on an a-C:H coating without a run-in layer.*

3 *No adhesions on an a-C:H coating with a run-in layer.*

**Outlook**

The surface state of a run-in a-C:H tool coating can potentially be set via a specific surface treatment. In future, a method is to be developed for reproducing this state based on a plasma-chemical and thermal treatment and structuring of the a-C:H layers. The aim is to provide optimized a-C:H tool coatings for the dry forming of aluminum sheets.

Frictional behavior of a-C:H coatings with and without a run-in coating against aluminum sheets made of EN AW-5083.




# CONTACT

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