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Mechanical and structural properties of thin sputtered a-C and CNx layers to polymer substrates

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Amorphous carbon layers in many forms have been studied for decades and it is recently used in many industrial applications. These carbon layers are often used due to its good protecting, low friction and low wear properties. PACVD techniques based on discharge in hydrocarbons or hydrogen/hydrocarbon mixture is mostly used and studied.
We have studied amorphous carbon and nitrogen doped carbon layers prepared by pulsed DC magnetron sputtering of graphite target in argon and argon/nitrogen process gas mixture. Our layers were deposited on various polymer substrates (PBT, PA, PA+PTFE, glass-fibers reinforced PA, PP, POM). These materials were selected due to their frequent utilization in industrial transport systems, which is target application of our layers. Our aim is to reduce energy consumption reducing friction losses and by extending durability of polymer parts using protective and lubricating layer based on amorphous carbon.
Properties like intrinsic stress, adhesion, wear resistance, friction coefficient and surface topography of treated substrates and deposited layers have been investigated using stylus profilometer, AFM, SEM and other self-made or self-modified tools. Friction and wear tests were made at conditions similar to those we expect in real transport systems.
We found, we can deposit extremely adherent a-C and CNx layers to most of substrates. No significant wear and stable friction coefficient was found during long term friction tests (coated polymer sliding on PE counterpart). Using plasma etching treatment, we were able to improve adhesion to PP. Adhesion to was very poor at all experimental conditions. The structure and intrinsic stress of prepared coatings on polymers strongly depend on deposition conditions.

Keywords
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