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# Development of hard and wear resistant tungsten doped DLC coatings for dry rotary swaging tools

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Rotary swaging is an incremental cold metal forging process formanufacturing of rotationally symmetric automotive components such asaxles or gear shafts in short cycle times. Nowadays, a good surface qualityof the manufactured work pieces and a minimized adhesive tool wear isachieved by an extensive use of lubricants usually made of crude oil. Theabsence of lubricant would improve the ecological balance and acceleratefor further work piece processing since complex cleaning steps becomeobsolete. However, preliminary applications tests under dry conditionsusing conventional tools exhibit heavy adhesive tool wear against steel andaluminum work pieces and result in insufficient work piece qualities up toprocess instabilities. In order to meet the requirements of dry rotaryswaging, non-adhesive hard and wear resistant multilayer coating systems(CrNx/a-C:H:W/a-C:H) based on tungsten doped amorphous carbon filmswere developed by reactive magnetron-sputtering. These coating systemsare characterized by low friction and high resistance against fatigue. Theinfluence of magnetron-sputtering parameters, tungsten content, heattreatment, surface pretreatment and the film design on the mechanicaland tribological properties of the multilayer coating systems wereexamined. Finally, real rotary swaging experiments with selected self-madeand coated tools under various rotary swaging conditions were performed.

**Keywords**
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