Title: Development of an ecological lubrication adapted to the shaping of metallic materials by grafting organic molecules

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This study explores the possibility of using more environmentally friendly and easy-to-clean lubrication in industrial stainless steel forming. This lubrication, rather related to surface functionalization, uses self assembled alkylphosphonic acid.

Two configurations can be used:

- The molecules keep solvated in a hydroalcoholic solvent, and will form an effective tribofilm, regardless of substrate roughness, sliding speed or contact pressure, systematically resulting in low wear and low friction coefficient. Specific tribological tests have been designed to analyze the dynamics of the lubrication mechanism. In these tests, the active molecules were introduced at the beginning or middle of the test and the dynamics of the friction response was studied in detail. It has been found that the grafting of molecules and their transformation into an effective tribofilm is a fast process (about a few seconds). Moreover, a very low concentration of the active molecule is sufficient to maintain the friction coefficient at a low and stable.

- The solvent is evaporated before the shaping operation. In this case, physisorbed species crystallize on the surface during evaporation and these will give the interface excellent tribological properties: the results revealed exceptionally low friction and wear thanks to a tribofilm from the shear of the aggregates. Tribofilm accumulates very quickly and has the advantage of reducing the coefficient of friction as the contact pressure increases.

The presentation demonstrates the high potential for general applicability of this lubrication technique to reduce the friction between a ferritic stainless steel sheet and a forming tool.

Biography

Xavier Roizard obtained his PhD in 1992 at the Laboratory of Surface Sciences and Techniques in Nancy (France) in the field of deep drawing tribology. Appointed as an associate professor in 1993, he successively became in charge of the tribology teams of the Corrosion and Surface Treatment, Materials and Interfaces Chemistry and Applied Mechanics laboratories.

In 2001, he obtained an accreditation to direct research and then supervised PhD students in the field of surface functionalization for tribological applications. In 2015, he was seconded for 1 year to the Angstrom laboratory in Uppsala, Sweden, to analyze the formation of tribofilms resulting from friction tests on metal surfaces functionalized with phosphonic acids.

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