

## The design and deposition of the self-lubricant films for green tribology applications

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**Abstract** The world is warming and the weather is becoming increasingly unstable and extreme, and the overwhelming scientific consensus is that mankind's use of fossil fuels and derivatives is a key component in this climate change. Friction, wear and lubrication are major players in the consumption of energy and, so, reducing friction and wear and using green lubrication is the most direct route to decrease the energy consumption and pollution and, so, contributing to a better environment for everybody. The scientific community has developed different type of coatings based on different adaptive mechanisms: (i) structural transitions with hexagonal solid basal plane formation (e.g. TMDs for temperatures  $\leq 300$  ° C), (ii) diffusion of soft metal (SMe) to contact surface (e.g. Ag in hard matrix for temperatures 300-500 °C) and (iii) lubricious oxides formation at contact surface (e.g. Magneli phases, double and ternary oxides for temperatures 500-1000 °C). These coatings are able not only to reduce friction and wear but they can also increase the lifespan of coated components. However, when parts are exposed to high temperature conditions, premature failure of the components occur due to low oxidation resistance of the coatings and/or fast/total diffusion of the lubricious element to the surface. The objective of this work is to develop a universal coating system, designed to provide low friction and green-tribology solutions for a wide range of temperatures for aerospace/auto motive (piston rings and fuel injectors) and machining industry that will alleviate the reliance on harmful oils and dramatically reduce the energy consumption and its effects on climate change and pollution. To achieve such an effect, novel materials combining low/medium with high temperature lubricious layers should be developed as well as a suitable multilayer architecture should be optimized. Experimental and simulation studies will be employed to optimize the structure and the architecture of the coatings to ensure the formation of low friction tribolayers in a wide range of temperatures. Tribolayers lubricious behaviors, including the diffusion of lubricious phase and the formation and phase transformation of in-situ tribo-phases, will also be investigated and simulated for different temperatures to design coatings with, structure and architecture.