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Project:	Densely Packed Fluoro-Hydro Alkyne Self Assembled Monolayers on Si(111), SiC and TiN Surfaces
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Fields of interest:	Fluoro-hydro organic monolayers; oxide-free silicon; low friction and adhesion surfaces.
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Introduction

For the application in high performance technological devices, studies on non-wear and low frictional surfaces are very important. In particular, the nanotribological behaviour of fluoro-hydrocarbon organic monolayer has been widely studied in order to produce durable and low frictional lubricants. This type of organic films on solid surfaces acts as lubricant for sliding or rolling by lowering the static and dynamic friction and wear. Silicon is the primary material in many micro-components, such as MEMS and NEMS, whose dimensions are a few to several hundreds of microns. At these small scales, surface properties, such as Van der Waals forces, greatly influence the performance of the frictional properties. Hence, several types of organic monolayer have been proposed, which are expected to considerably enhance the tribological properties of silicon.

Aim

The aim of this project is to develop wear resistant surfaces. We will study the tribological properties of Si(111), SiC and TiN after surface modification with fluoro-hydro alkynes (**Figure:1**). Organic monolayers of fluoro-hydro alkynes have high wear resistance as well as resistance to chemical attack. We intend to employ these surfaces to achieve good tribological performance under a wide range of conditions.

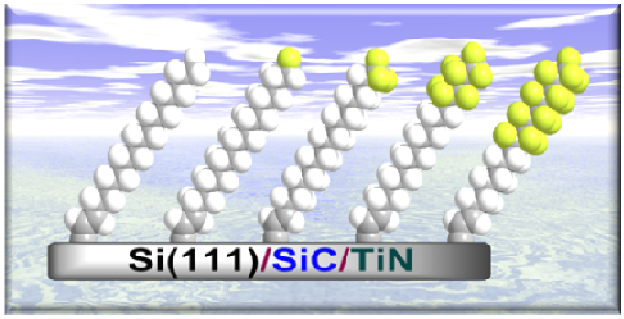

Figure:1 Schematic representation of fluoro-hydro monolayers on Si(111), SiC and TiN.

Research

New fluoro-hydro containing alkynes were synthesized and these fluoro-hydro alkynes were self-assembled onto Si(111) substrates into highly ordered monolayer films. As might be expected, the SAMs exhibit an excellent hydrophobicity with a water contact angle of 110 to 119°. X-ray photoelectron spectroscopy demonstrated the chemical shift (687 eV for F1 to 689 eV for F17) of the F_{1s} peak. The shift of 2 eV for these monolayers the typical fluorine molecular solids in which the van der Waals force only supports attractive interaction among molecules. The IRRAS results show that fluoro-hydro SAMs has the anti-symmetric CH_2 stretching at 2918 to 2920 cm^{-1} and symmetric stretching at 2850 to 2951 cm^{-1}, indicating that the original methylene spacers exists in highly ordered crystalline conformations throughout the entire fluoro-hydro monolayer series.

Conclusion

An C16 alkyne with an F0, F1, F3, F9, and F17 fluoro-hydro alkyne segment were synthesized and these molecules were self-assembled on to Si(111). The monolayers were found to be uniform and reproducible, densely packed, oxide free and exhibiting hydrophobic characteristic. Both IRRAS and ellipsometric measurements clearly show the fluoro-hydro alkyne segment are highly ordered onto Si(111) surface. Water contact angle measurements show that the hydrophobicity increases with increase the fluorine atoms in chain. The less fluorine alkyl chains formed densely packed layers due to the strong interaction between the chains.

Acknowledgement

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References

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