

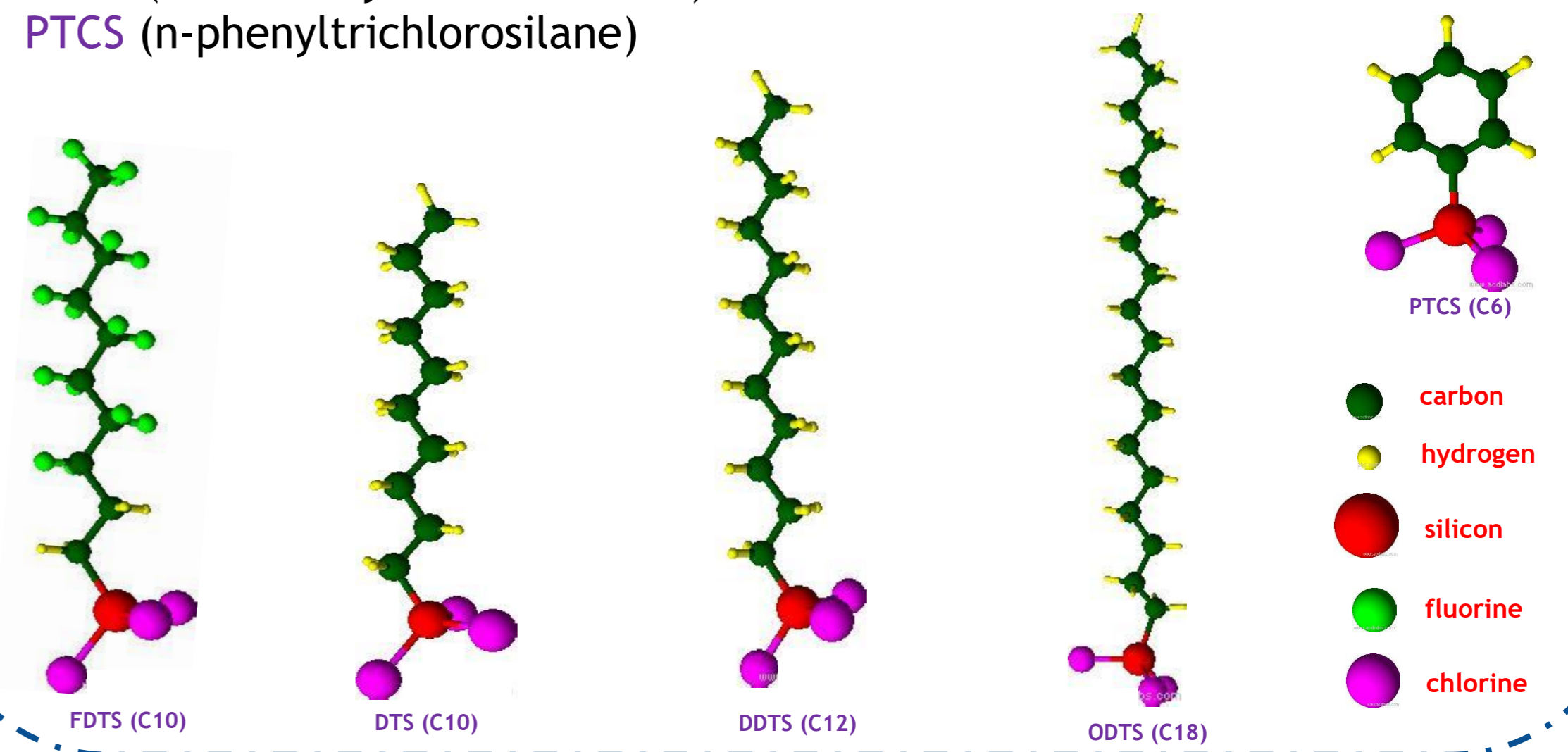


INTRODUCTION

Due to the increasing miniaturization and interest in nanotechnology, new nanomaterials are investigated or modified. In order to increase the functionality and efficiency of devices, self-assembling monolayers are used to improve the hydrophobic, mechanical and tribological properties. The aim of this study was to produce one- and two-component monolayers by the vapor deposition method with PDMS stamp. The modification was carried out on Ti-DLC substrate with a titanium content of 5.86%. On the basis of the conducted research, a correlation between the structure of the used modifiers forming self-assembled monolayers and the obtained properties was found.

Organosilane compounds:

- FDTS (1H, 1H, 2H, 2H - perfluorodecyltrichlorosilane)
- DTS (n-decyltrichlorosilane)
- DDTS (n-dodecyltrichlorosilane)
- ODTS (n-oktadecyltrichlorosilane)
- PTCS (n-phenyltrichlorosilane)

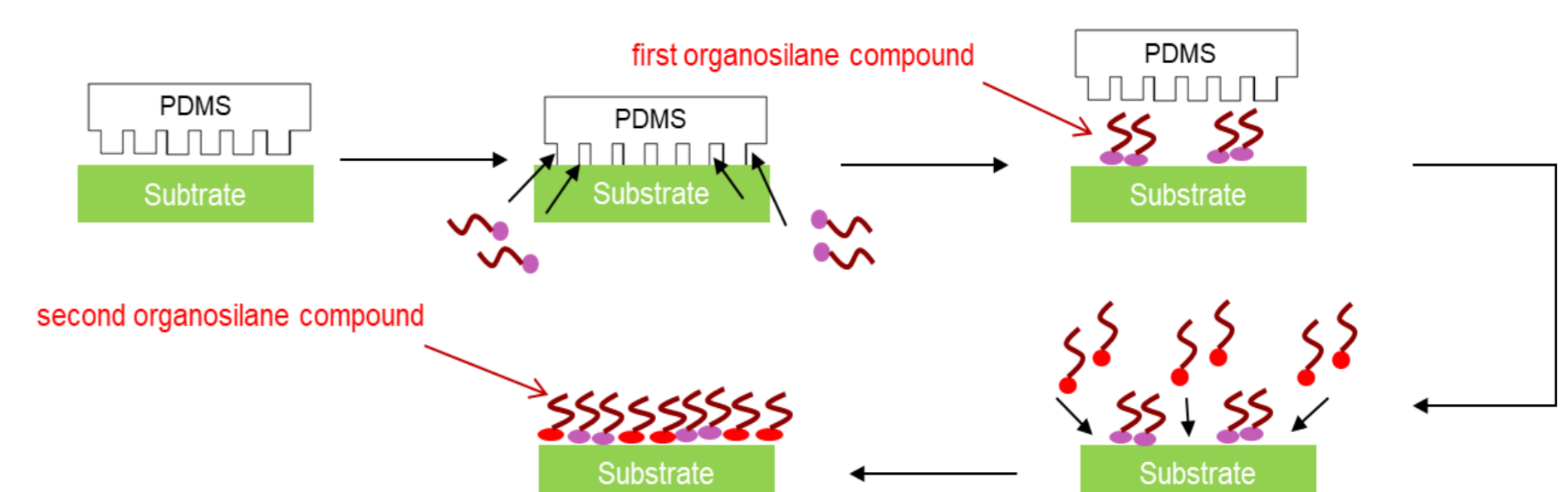


EXPERIMENTAL

Modification of Ti-DLC surface by one-component organosilane films:

- 1) activation of modified substrate by low-temperature plasma
- 2) creation and control of pressure inside a reaction chamber
- 3) treatment of hydrolyzed surface by modifier vapor
- 4) placing the modified substrate in the oven for ordering of the resulting self-assembled monolayer

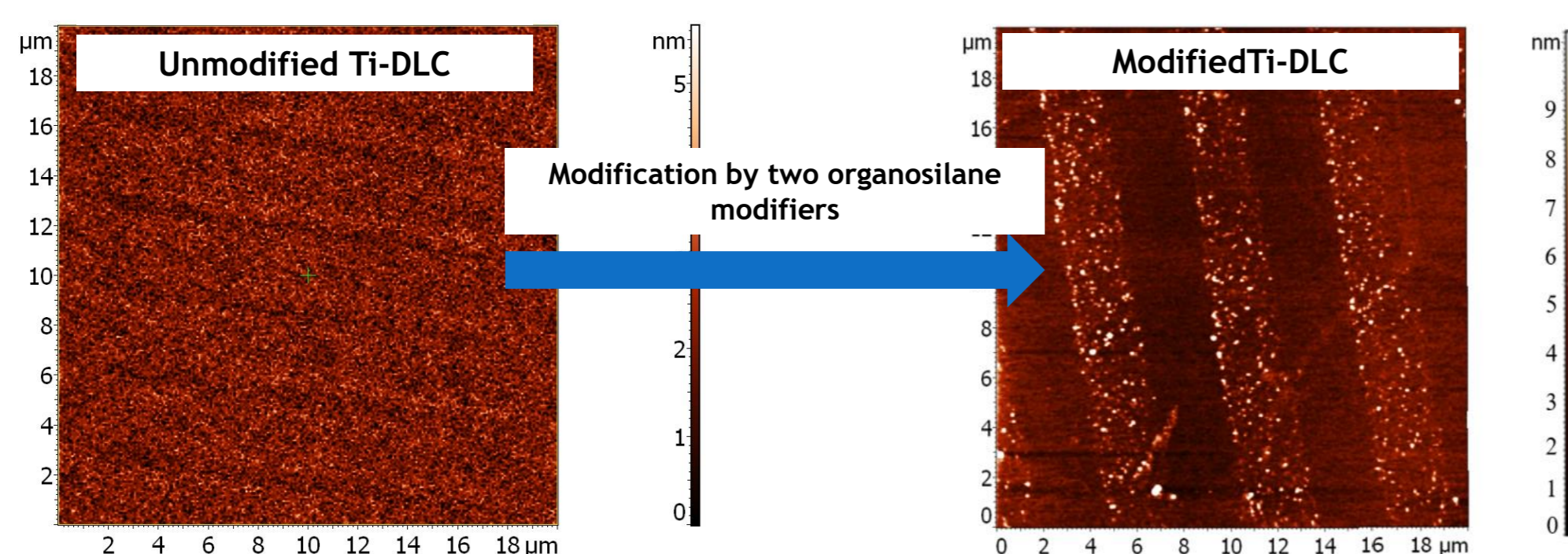
The modification process of the surface by two organosilane compounds using vapor phase deposition method with PDMS stamp:



The modification process:

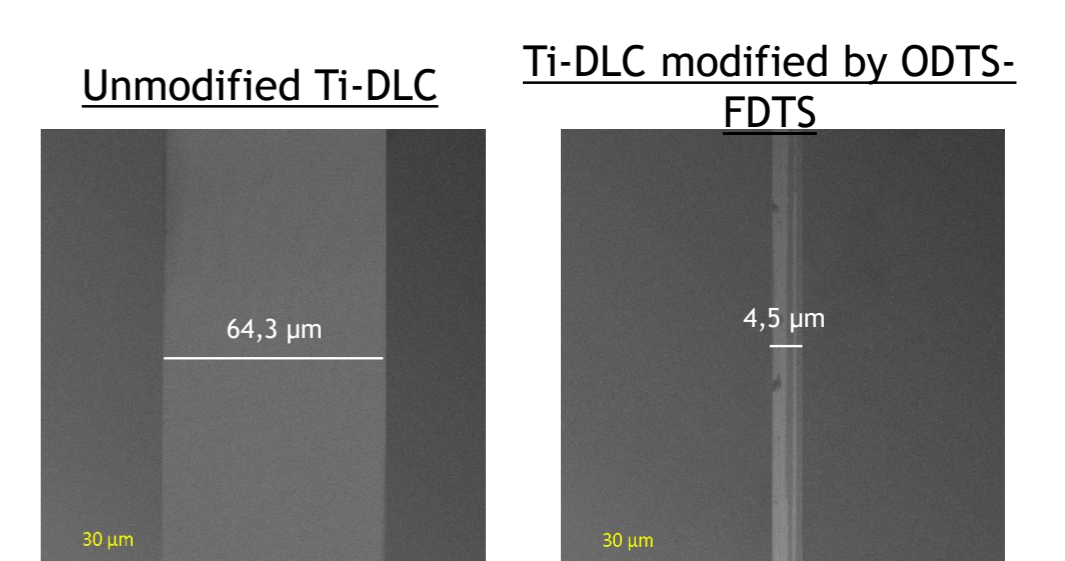
- 1) placing PDMS stamp on activated surface
- 2) modification by first organosilane compound
- 3) removing PDMS stamp from modified surface
- 4) modification by second organosilane compound

Topography studies using atomic force microscopy:

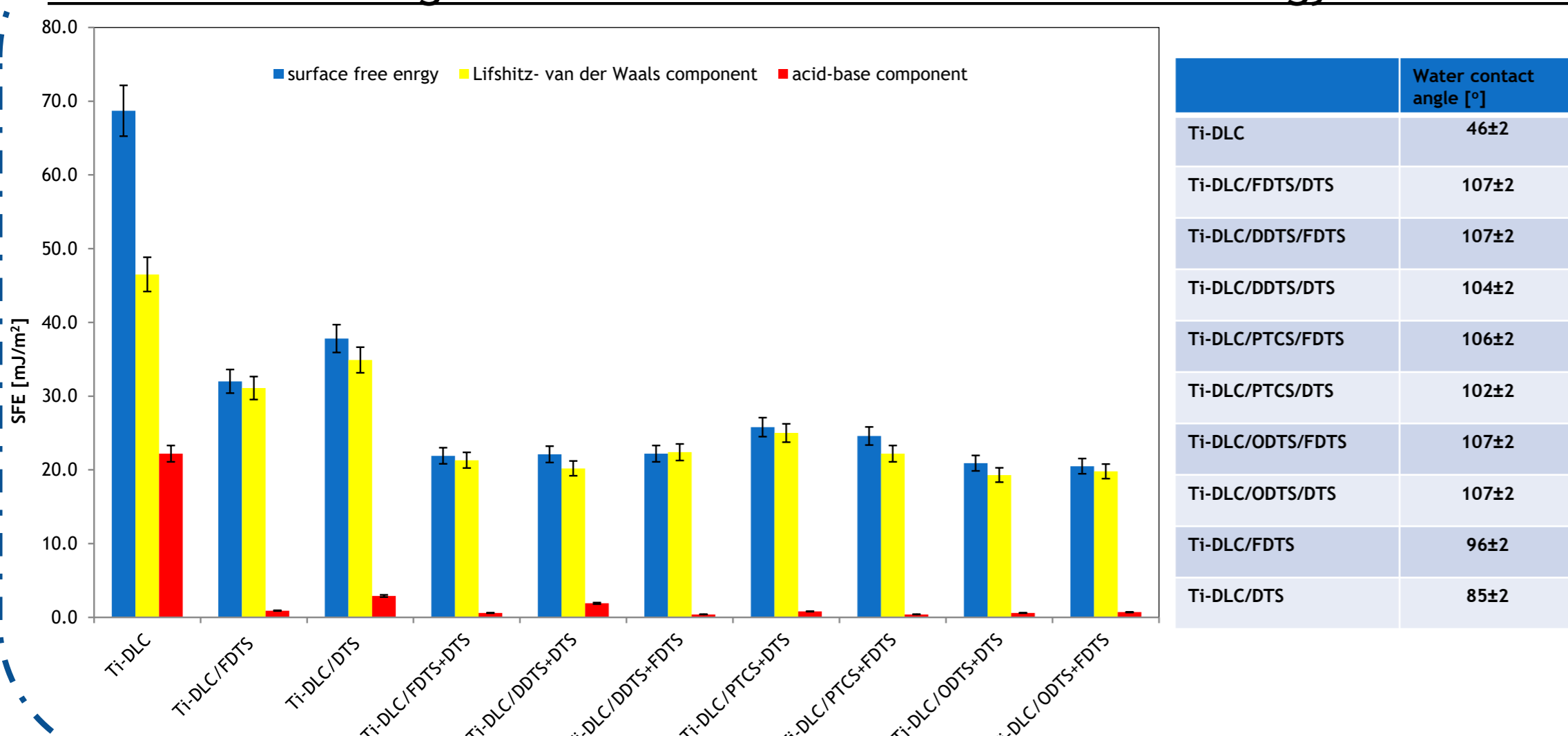


Wear resistance of obtained monolayers after tribological tests:

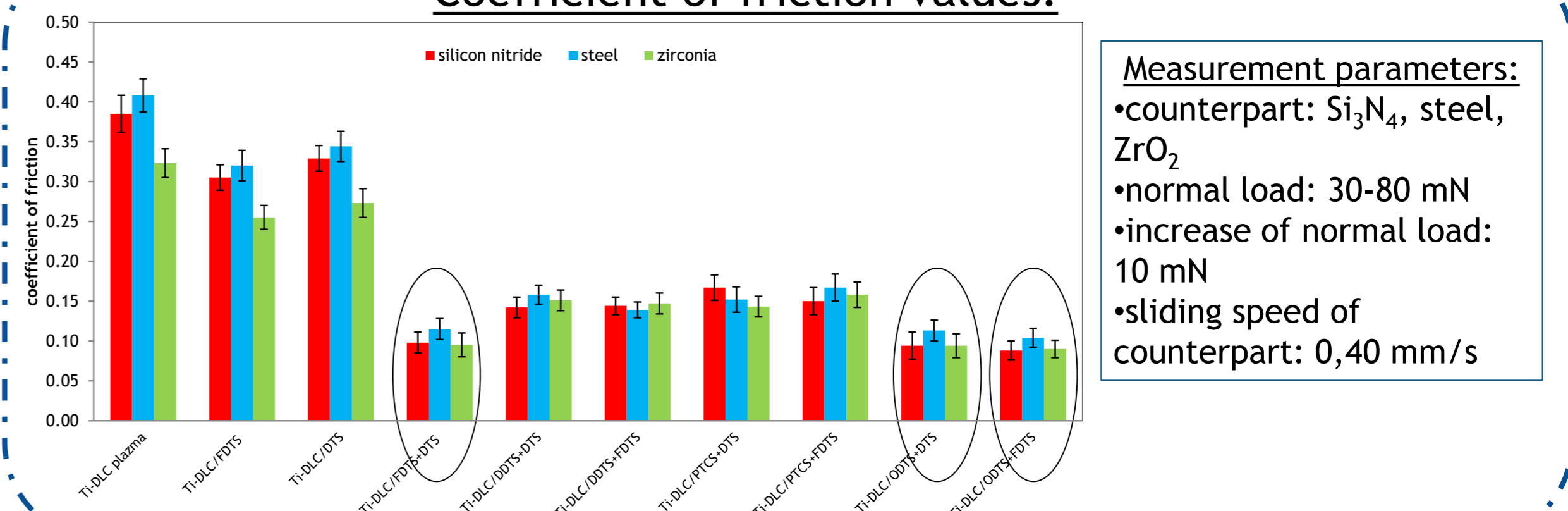
Substrate/modifier	Width of wear tracks [μm]
Ti-DLC	64,3
Ti-DLC /FDTS	24,4
Ti-DLC /DTS	38,6
Ti-DLC /FDTS-DTS	4,2
Ti-DLC /DDTS-DTS	4,3
Ti-DLC /DDTS-FDTS	4,5
Ti-DLC /ODTS-DTS	4,0
Ti-DLC /ODTS-FDTS	4,7
Ti-DLC /PTCS-DTS	5,7
Ti-DLC /PTCS-FDTS	4,7



Water contact angle measurements and surface free energy calculations:



Coefficient of friction values:



CONCLUSIONS

- Vapor phase deposition method with PDMS stamp make possible to create two-component ultrathin organosilane monolayers on Ti-DLC surfaces
- Surfaces with adsorbed organosilane compounds have: higher values of water contact angle, lower values of surface free energy and friction coefficient in comparison with unmodified surfaces
- Two-component organosilane monolayers formed on investigated substrates have rough structure (difference in height between the strips is about 6 nm) and therefore they have better hydrophobic and tribological properties than one-component analogs
- Two-component organosilane thin films reduce the coefficient of friction by 45-65% in comparison with one-component layers
- The following two-component layers have the best hydrophobic and tribological properties: FDTS-DTS, ODTS-DTS i ODTS-FDTS