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RNA-directed modular construction as smart processing tool for nanotechnology

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1.- INTRODUCTION

In order to achieve the integration of such synthetic viral architectures into technical devices at predestinated sites, concepts for the site-specific self-assembly of TMV coat protein subunits directed by RNA immobilized on different inorganic surfaces are introduced. This is accomplished with a new approach in silane chemistry: The use of Isothiocyanate-terminated silane for covalent attachment of amino functional biomolecules on inorganic surfaces. Furthermore, we were able to combine this technique with a site-selective oxidation of polymer surfaces, allowing patterned assembly of TMV-like architectures.

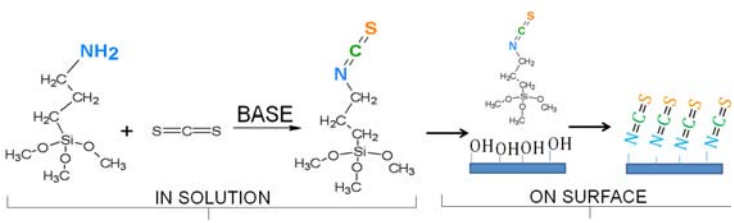

Fig. 1.- Scheme for synthesis of isothiocyanatepropyltrimethoxysilane from aminopropyltrimethoxysilane and subsequent self assembly monolayer (SAM) formation

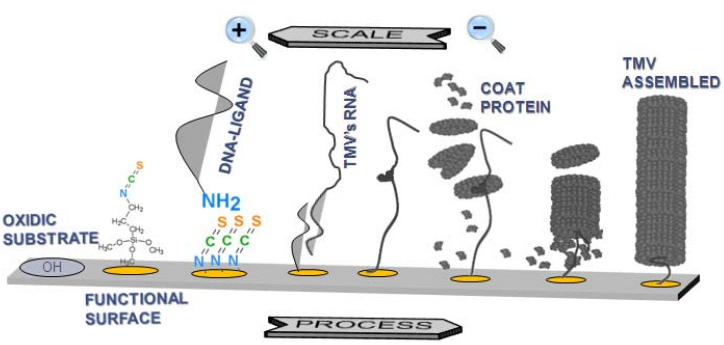

Fig. 2.- Self assembly process of Tobacco Mosaic Virus on an oxidic functionalized surface. From left to right, the silanization on the surface and the biological assembly step-by-step.

2.- SELF-ASSEMBLY ON FUNCTIONALIZED SURFACES

The development of silane and thiol-based functionalization in combination with patterning processes (polymer blend lithography, stamping techniques, AFM-Lithography, UV lithography) for surfaces are used to selectively control the RNA-binding and thus the growth of bio-template columns can be spatially oriented.

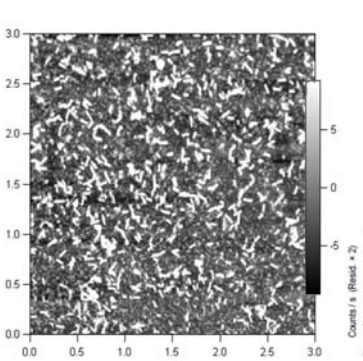

Fig.3.- AFM topographic image of TMV/like particles self assembled according to Fig.-2 on an isothiocyanate functionalized surface (silicon wafer).

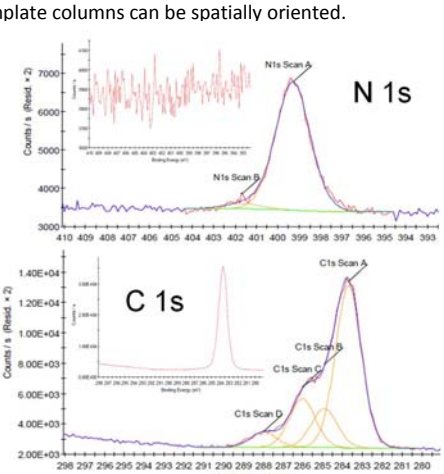

Fig.4.- XPS spectra from Nitrogen 1s and Carbon 1s before (inset) and after silanization.

3.- SELF ASSEMBLY ON FUNCTIONALIZED STRUCTURED SURFACES

Fig. 5.- Scheme of polydimethylsiloxane (PDMS) substrate treated and silanized with isothiocyanate groups, with subsequent TMV assembly.

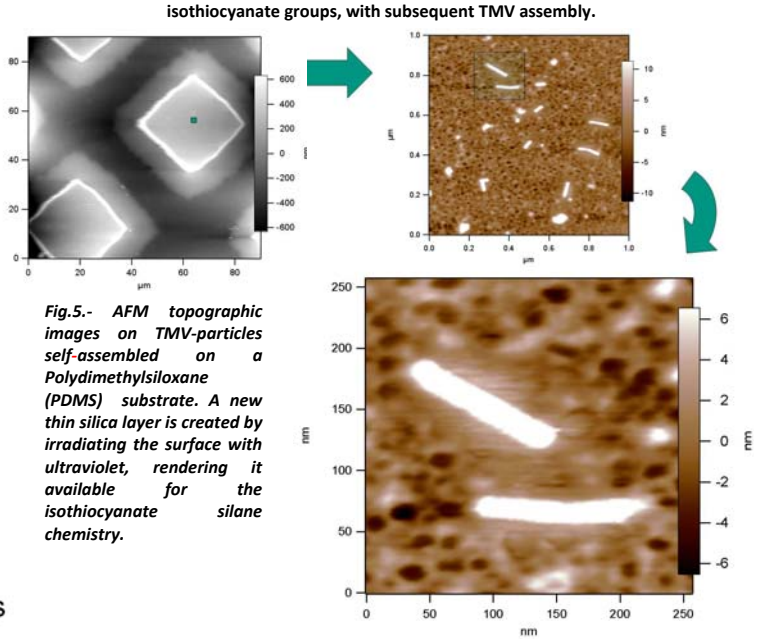

Fig.5.- AFM topographic images on TMV-particles self-assembled on a Polydimethylsiloxane (PDMS) substrate. A new thin silica layer is created by irradiating the surface with ultraviolet, rendering it available for the isothiocyanate silane chemistry.

4.- OUTLOOK

1.- Vertically orientation
2.- Functionality available on the CP/ Barcoding
3.- Functionality available at the terminal groups/ sensoring
4.- RNA-Tree shape ability