Electro-active elastomer composite based on doped titanium dioxide

Alaedine Kossi*, Georges Bossis and Jacques Persello

Laboratoire de Physique de la Matière Condensée LPMC, CNRS UMR 7336, University of Nice-Sophia Antipolis, Parc Valrose 06108 Nice, France

*Corresponding author: Alaedine Kossi; Tel: +33 492 076 535; E-mail: alaedine.kossi@gmail.com

Electronic supplementary information:

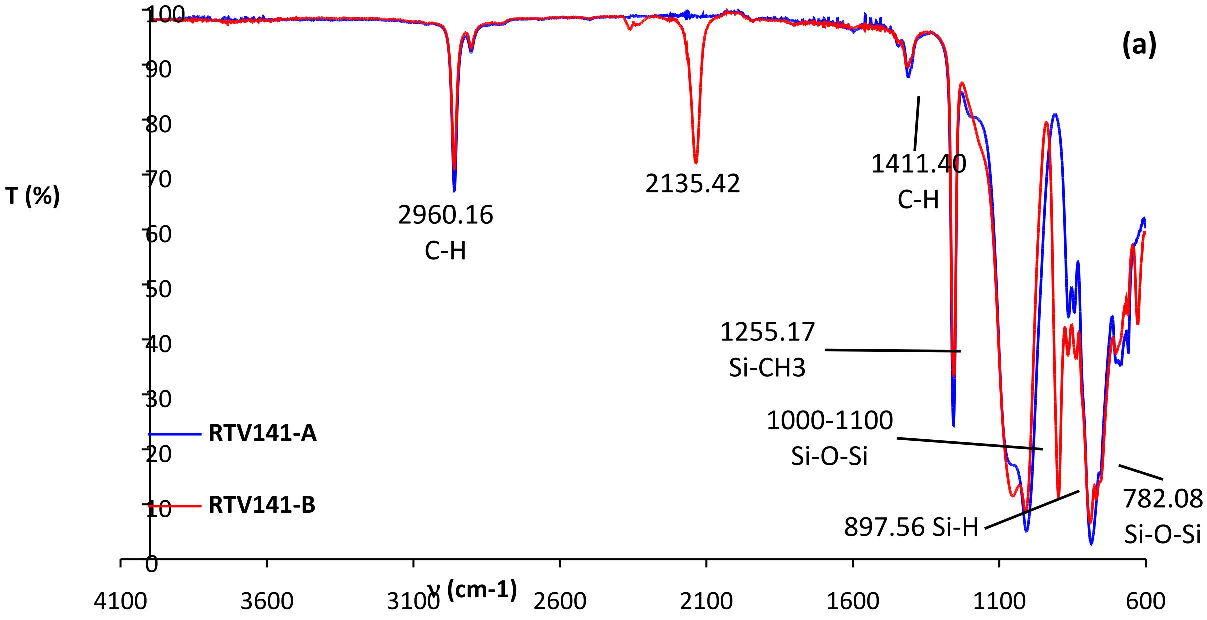
Morphological characterization

Electron Microscopy was performed on the CCMA EM Core Facility (University of Nice Sophia Antipolis) using a SEM apparatus (JEOL 6700F) and a TEM apparatus (120 KV JEOL JEM-1400) to characterize the TiO_2 morphology.

N2 adsorption/desorption isotherms were obtained using BELSORP apparatus (BEL Japan, Inc.). The specific area of TiO_2 was obtained from the BET-Plot using Belsorp Adsorption/Desorption Data Analysis Software.

The Small Angle Neutron Scattering (SANS) characterization was performed in the Institut Laue-Langevin (ILL) using the D11 instrument. Three sample – detector distance (SD) were used: SD= 36.7 m with neutrons incident wavelength λ=13 A°, SD= 20 m with neutrons incident wavelength λ=6 A° and SD= 5 m with neutrons incident wavelength λ=6 A°.

The FT-IR spectra of RTV141-A pre-polymer, RTV 141-B pre-polymer, pure cross-linked RTV141 (A+B), TiO_2-Acac/RTV141 (A+B) and pure TiO_2 were carried out using a FT-IR Spectrum BX System (Perkin Elmer). Each spectrum was recorded in the frequency range 600 - 4000 cm^{-1} with 2 cm^{-1} of resolution and a number of scan fixed at 112. The obtained results are shown in **Figure 1S (a), (b)** and **(c)**.



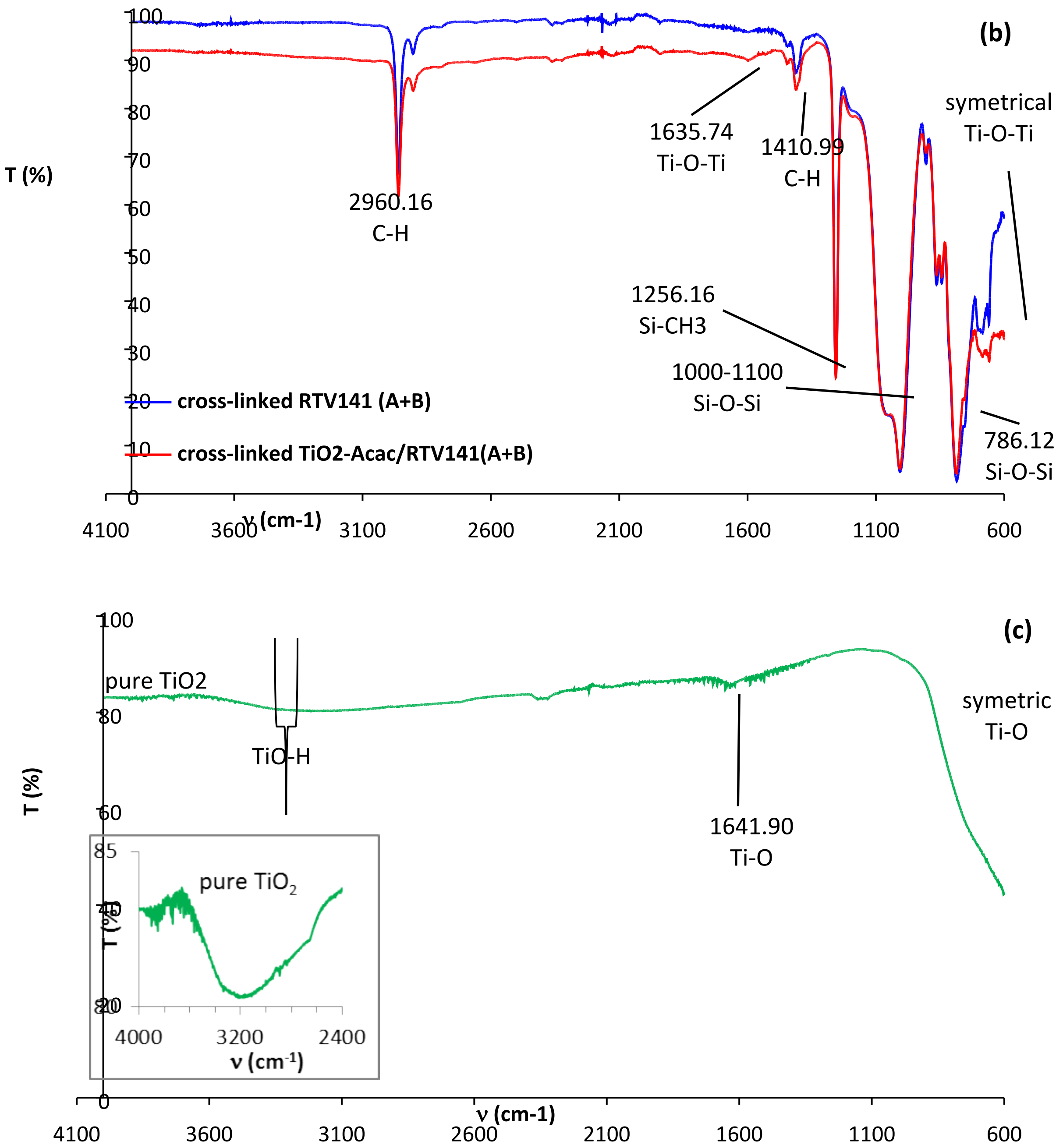


Figure 1S: FT-IR spectra of; **(a)** RTV141-A (bleu curve) and RTV141-B (red curve); **(b)** cross-linked RTV141 (A+B) (blue curve) and TiO_2-Acac/RTV141(A+B) (red curve); **(c)** pure TiO_2 (inset: pure TiO_2 at high frequencies range).

Figure 1s (a) shows that FT-IR spectra of RTV 141-A and RTV141-B pre-polymers are similar due to the same skeleton (siloxane) of both RTV 141-A and RTV141-B. The difference between the two lies in the presence of Si-H bonds in RTV141-B that are characterized by absorption peaks at 2135.24 and 897.56 cm^{-1}. These two peaks are used for following the cross-linking reaction of the RTV141 by hydrosililation. Indeed, as shown in Figure 1S (b), the characteristic absorption of Si-H bonds disappear in the FT-IR spectra of both cross-linked TiO_2-Acac/RTV141 and RTV141confirming the total hydrosililation cross-linking reaction. In the FT-IR spectra of TiO2-Acac/RTV141, due to the strong absorption of

Ti-O and Si-O bonds and their superposition with the characteristic vibrations of the (C-C) and (C-O) (originated from the Acac) at low frequencies and due the small concentration of the Acac in the sample the presence of adsorbed Acac cannot be easily evidenced. In Figure 1s (c), it is shown the FT-IR spectra of pure TiO_2 calcined at 500 °C. The broad and weak peaks centered around 3200 cm^{-1} (characteristic of OH bonds of TiOH) may be originated from the contamination of the sample by the moistures. The weak peak at 1641.90 cm^{-1} and the intense broad peak for $\upsilon<1100$ cm^{-1} were attributed to asymmetrical and symmetrical vibrations of Ti-O bonds respectively.

Dielectric properties measurements:

Apparatus used: Solartron SI1260 Impedance/Gain Phase Analyser with the Dielectric Interface Solartron 1296 and Sample Holder 12962 Sorlatron.

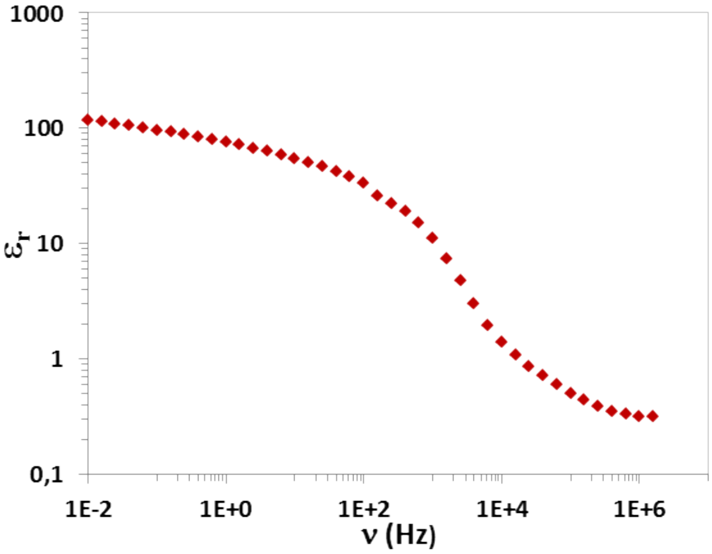


Figure S2: The dielectric constant of TiO_2-Acac ε_r was obtained by measuring the relative permittivity ($\varepsilon_{r\ eff}$) of TiO_2-Acac pellet (Φ_v=0.44) and assuming that $\varepsilon_r = \varepsilon_{r\ eff} / \Phi_v$.