Supplementary information

Probing the impact of material properties of core-shell SiO_2@TiO_2 spheres on the plasma catalytic CO_2 dissociation using packed bed DBD plasma reactor

Periyasamy Kaliyappan[a], Andreas Paulus[a,g], Jan D'Haen[b], Pieter Samyn[c], Yannick Uytdenhouwen[f], Neda Hafezkhiabani[f], Annemie Bogaerts[f], Vera Meynen[d,e], Ken Elen[a,g], An Hardy[a,g] and Marlies K. Van Bael[a,g,*]

[a] Hasselt University, Institute for Materials Research (imo-imomec and Energyville), Materials Chemistry, DESINe group, Agoralaan Building D, 3590 Diepenbeek, Belgium

[b] Hasselt University, Institute for Materials Research (imo-imomec), Materials Physics, ELPHYC group, Wetenschapspark 1, 3590 Diepenbeek, Belgium

[c] Hasselt University, Institute for Materials Research (imo-imomec), Materials Chemistry, ACC group, Agoralaan Gebouw D, 3590 Diepenbeek, Belgium

[d] University of Antwerp, Department of Chemistry, Laboratory of Adsorption & Catalysis (LADCA), Universiteitsplein 1, Wilrijk 2610, Belgium

[e] Flemish Institute of Technological Research (VITO), Boeretang 200, 2400 Mol, Belgium

[f] University of Antwerp, Department of Chemistry, Research group PLASMANT, Universiteitplein 1, Wilrijk 2610, Belgium

[g] IMEC vzw, IMOMEC, Wetenschapspark 1, 3590 Diepenbeek, Belgium

* Corresponding author.

E-mail address: marlies.vanbael@uhasselt.be

Raman spectroscopy:

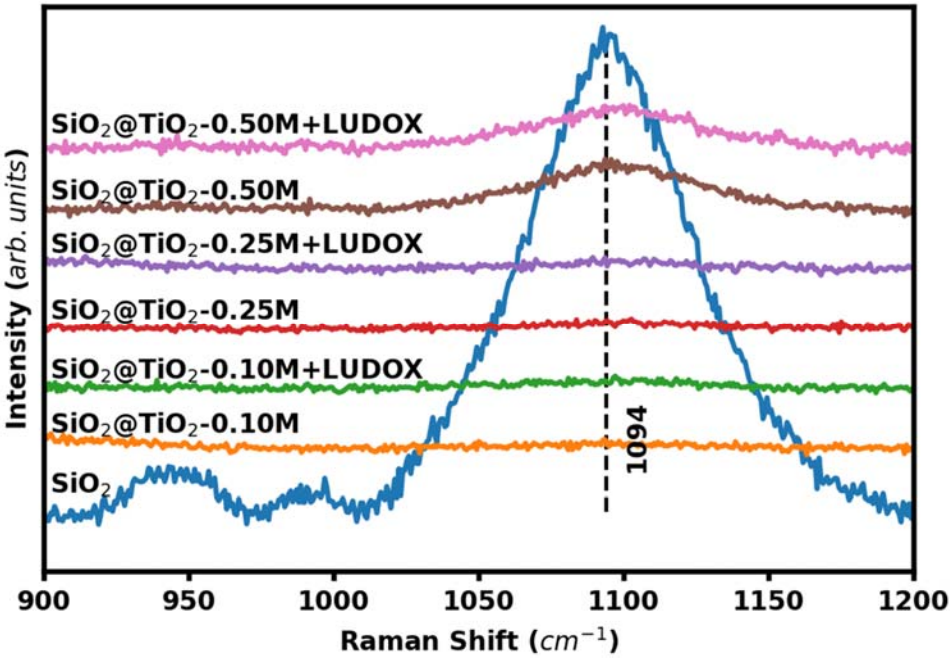


Figure S1. Comparison of SiO_2 Raman modes in as-prepared core-shell spherical particles and bare SiO_2 spherical particles

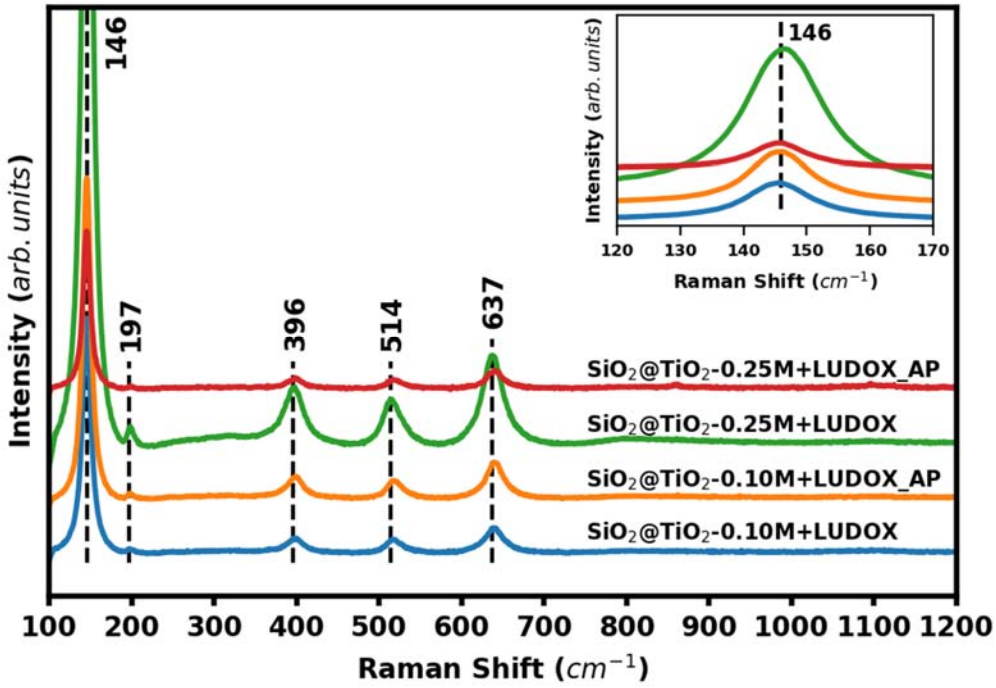


Figure S2. Raman spectroscopy of fresh and spent SiO_2@TiO_2 – 0.10M+LUDOX and SiO_2@TiO_2-0.25M+LUDOX materials (AP = After Plasma catalysis).

Scanning electron microscopy:

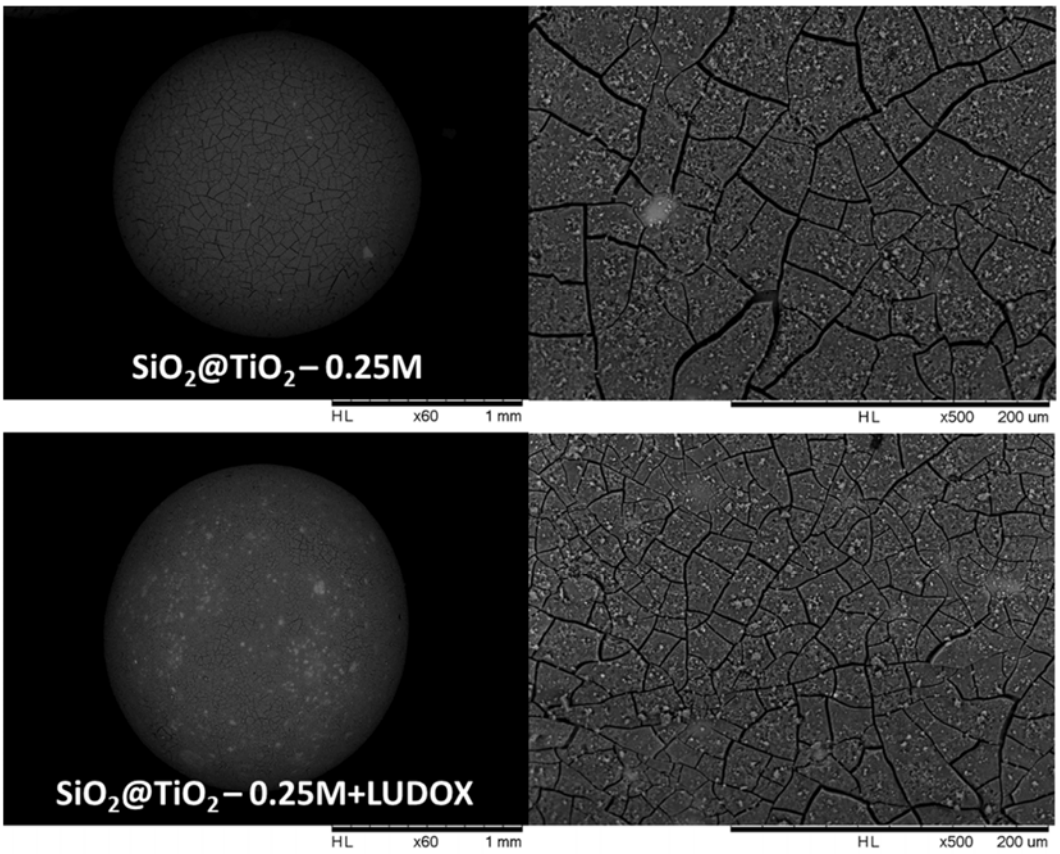


Figure S3: Scanning electron microscopy of uncalcined $SiO_2@TiO_2$ – 0.25M packing material with and without LUDOX

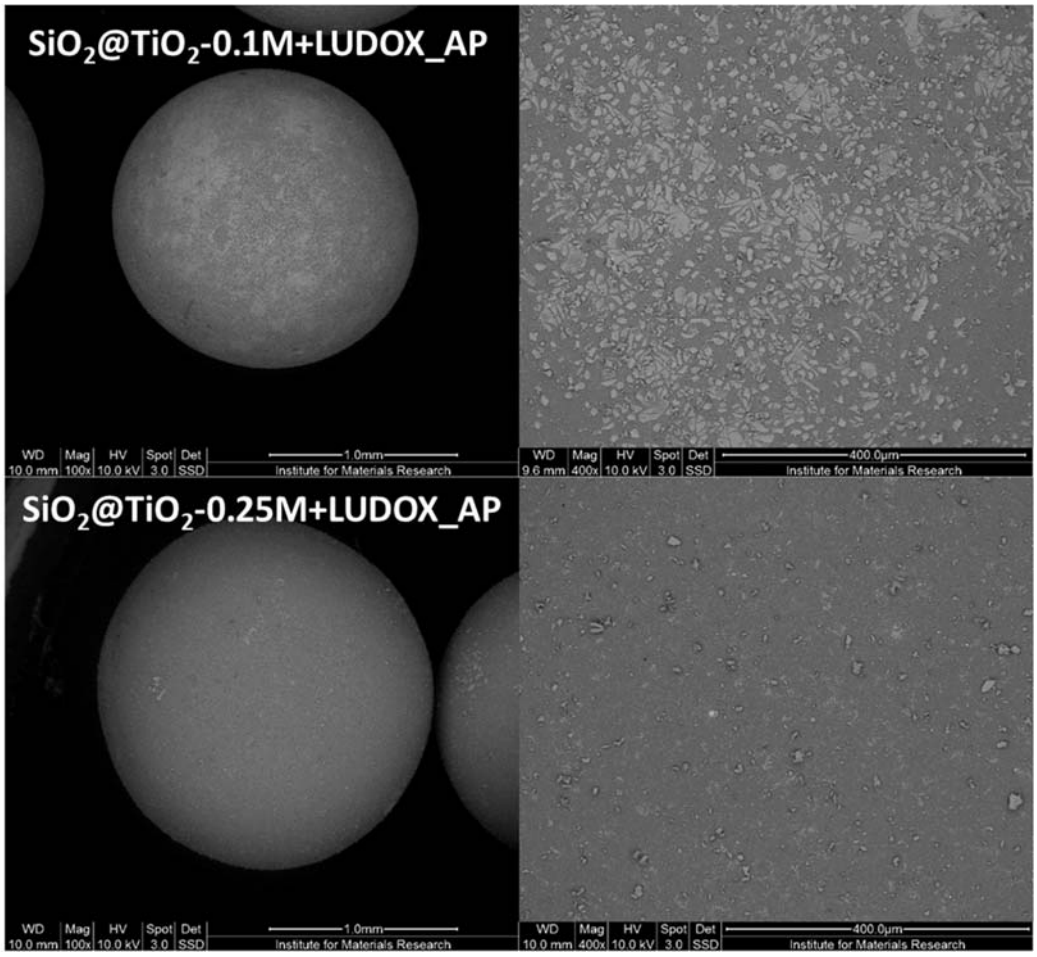


Figure S4: Scanning electron microscopy of SiO_2@TiO_2 – 0.10M+LUDOX and 0.25M+LUDOX packing materials after multi-point space time measurement.

Gas Hourly Space Velocity (h^{-1}):

$$\text{Gas Hourly Space Velocity } (h^{-1}) = \frac{Volume\ of\ feed\ flow\ gas\ (ml/h)}{Volume\ of\ catalyst\ (ml)}$$

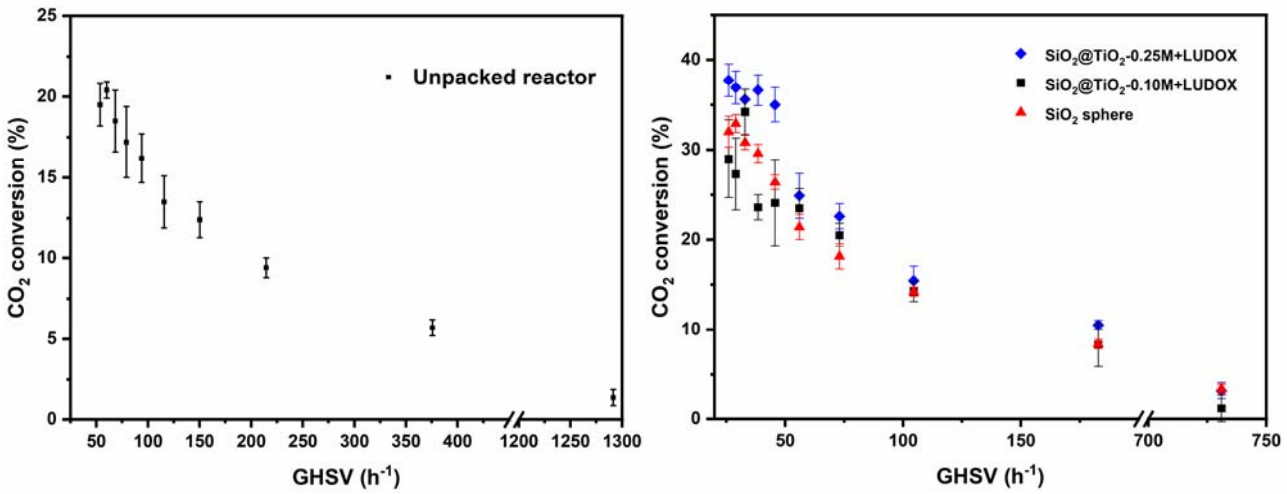


Figure S5. Plasma catalytic CO_2 conversion as a function of Gas Hourly Space Velocity (GHSV, h^{-1}) for unpacked and packed reactors

Multi-point space time measurements:

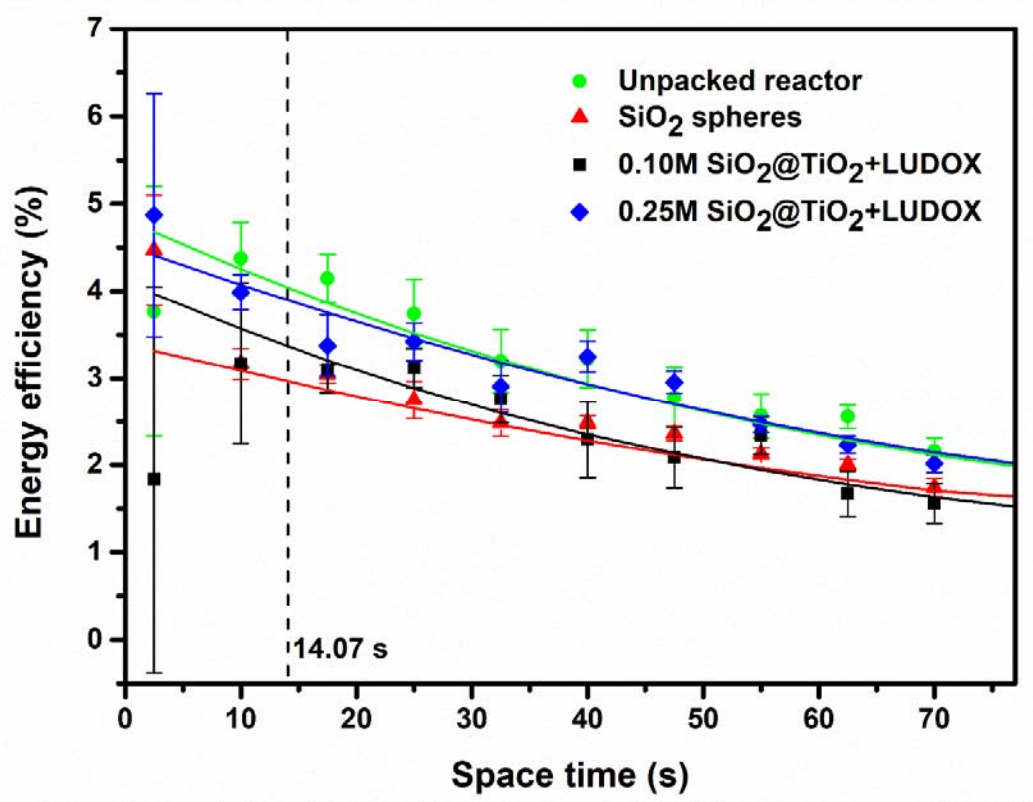


Figure S6. Energy efficiency of plasma catalytic CO_2 dissociation as a function of space time. The vertical dashed line corresponds to the single point residence time (14.07 s)