# Supporting information

## Carbon bed post-plasma to enhance the $CO_2$ conversion and remove $O_2$ from the product stream

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Supporting information includes 1) a scheme of the anode and basket; 2) SEM images for charcoal 1, before and after the gasification reactions; 3) TGA-MS under $O_2$ atmosphere for charcoal 1 and 2; TGA-MS under argon atmosphere for charcoal 1 4) as received, 5) after 45 s and 6) 7 minutes of reaction; 7) weight loss (TGA) for charcoal 1, before and after reaction; 8) $O_2$ concentration measured in the carbon bed; 9) the concentration profiles of $CO_2$, CO and $O_2$ and temperature measured in the carbon bed; Rate of the main heterogeneous reactions triggered by the carbon bed with $O_2$ as feed gas at 10) 1086 K and at 1502 K 11) at the beginning of the treatment and 12) after 10 minutes; 13) Rate of the main heterogeneous reactions triggered by the carbon bed with $CO_2$ as feed gas at 1412 K.

**Figure S1**


Figure S1. A. and B. Side view and front view of the anode. C. Anode and basket assembled.

**Figure S2**

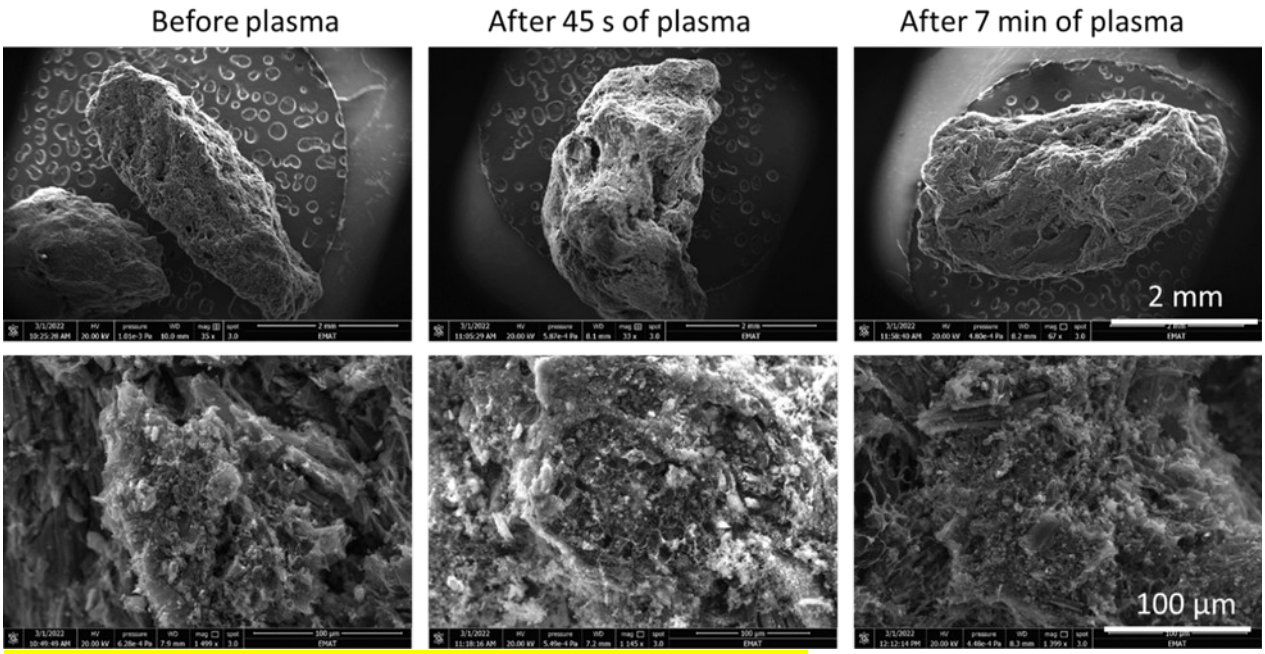


Figure S2. SEM images of charcoal 1, before and after the gasification reaction.

**Figure S3**

Figure S3. Partial pressure of $CO_2$ released from TGA-MS under $O_2$ atmosphere of charcoal 1 (dark blue) and charcoal 2 (light blue) and weight loss for charcoal 1 (orange dashed line) and charcoal 2 (red dashed line), as a function of the temperature and time.

**Figure S4**

Figure S4. TGA-MS under argon atmosphere of charcoal 1 as received.

**Figure S5**

Figure S5. TGA-MS of charcoal 1, top layer, after 45 s of reaction.

**Figure S6**

Figure S6. TGA-MS of charcoal 1, after 7 minutes of reaction.

**Figure S7**

Figure S7. TGA of charcoal 1, as received and after 45 s and 7 minutes of reaction.

**Figure S8**

Figure S8. $O_2$ concentration measured in real time with carbon bed, charcoal 1 (zoom in from Figure 5B in the main paper). 10L/min $CO_2$, SEI = 3.2 $kJ.L^{-1}$.

**Figure S9**

Figure S9. $CO_2$, CO and $O_2$ concentration profiles compared with the temperature profile obtained in the presence of the carbon bed. Charcoal 1, 10 $L.min^{-1}$ $CO_2$, SEI = 3.2 $kJ.L^{-1}$.

**Figure S10**

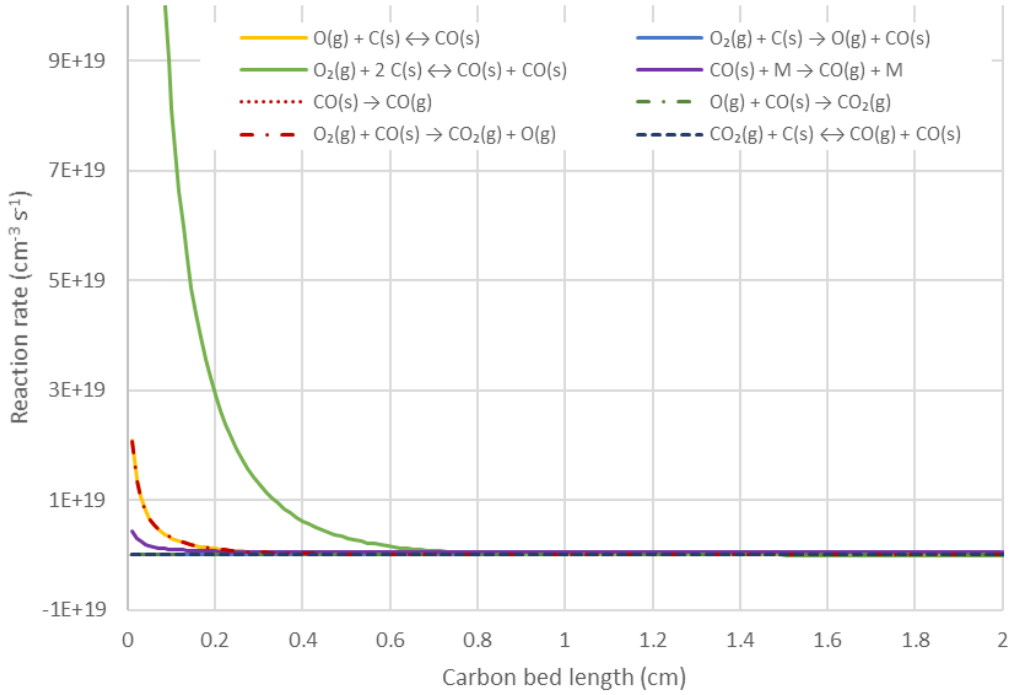


Figure S10. Rate of the main heterogeneous reactions triggered by the carbon bed at 1086 K, with $O_2$ as feed gas ($O_2$_E).

**Figure S11**

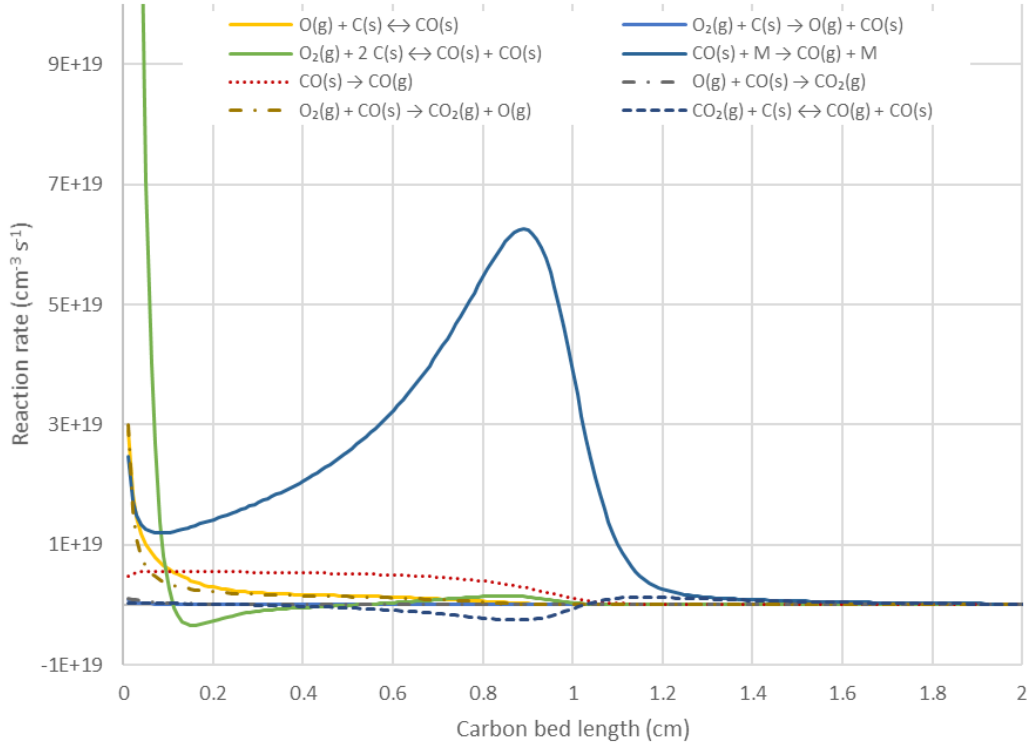


Figure S11. Rate of the main heterogeneous reactions triggered by the carbon bed at 1502 K, with $O_2$ as feed gas ($O_2$_H).

**Figure S12**

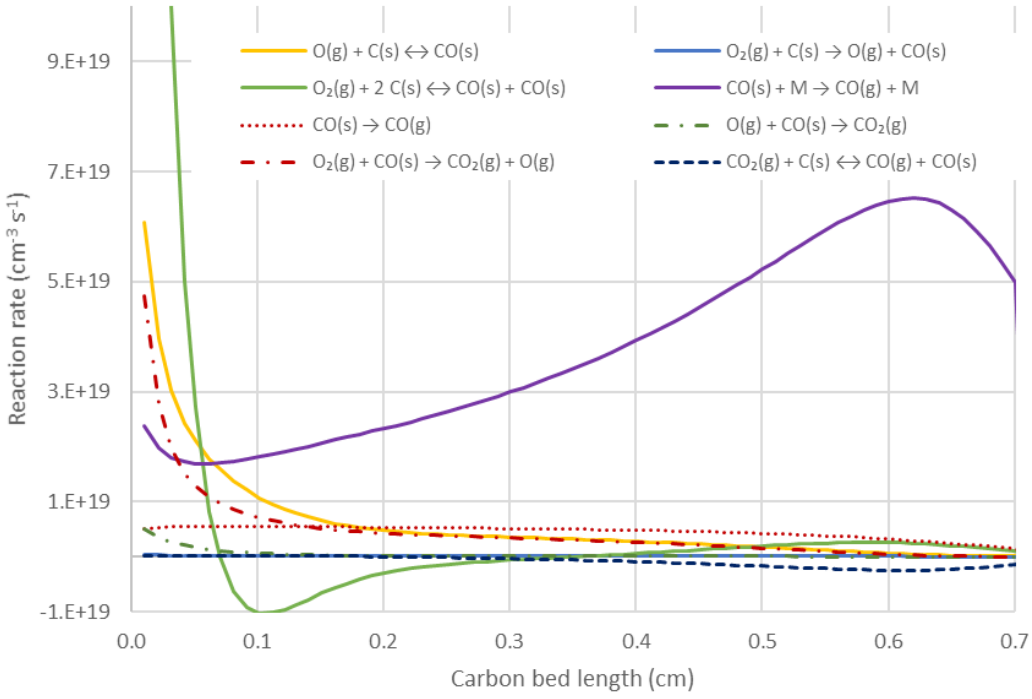


Figure S12. Rate of the main heterogeneous reactions triggered by the carbon bed at 1502 K, with $O_2$ as feed gas, after 10 minutes of treatment ($O_2$_$H_{600}$).

**Figure S13**

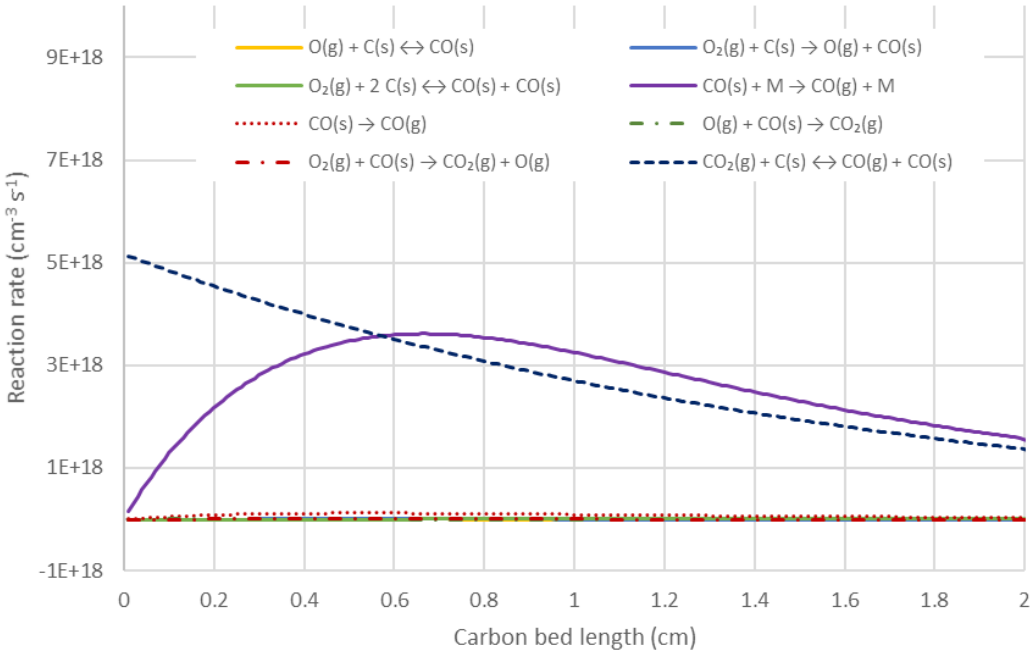


Figure S13. Rate of the main heterogeneous reactions triggered by the carbon bed at 1413 K, with $CO_2$ as feed gas ($CO_2$_H).