Supplementary Material (ESI) for Energy & Environmental Science
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Supporting Information

Co-production of graphene sheets and hydrogen by decomposition of methane using cobalt based catalysts

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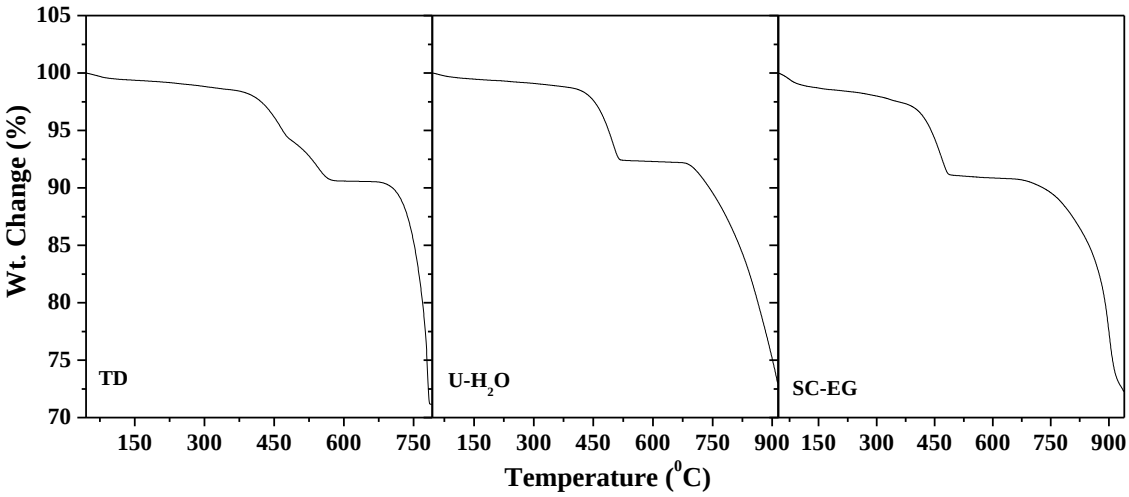

Fig. S1 Weight change of the catalysts during their reduction in presence of methane prior to the decomposition reaction.

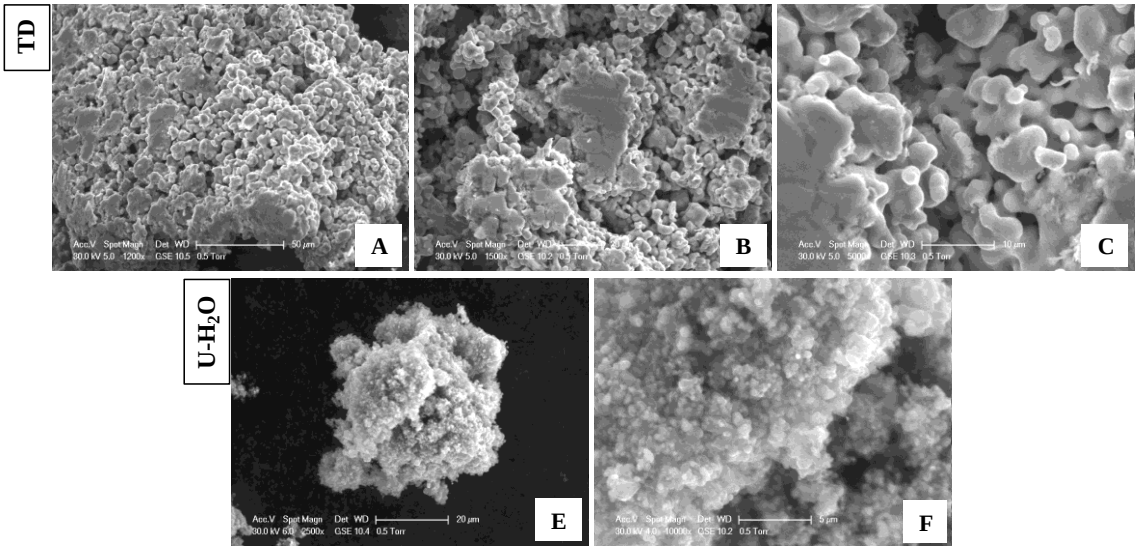

Fig. S2 SEM image of the used catalyst after the decomposition reaction with pre-reduction by methane.

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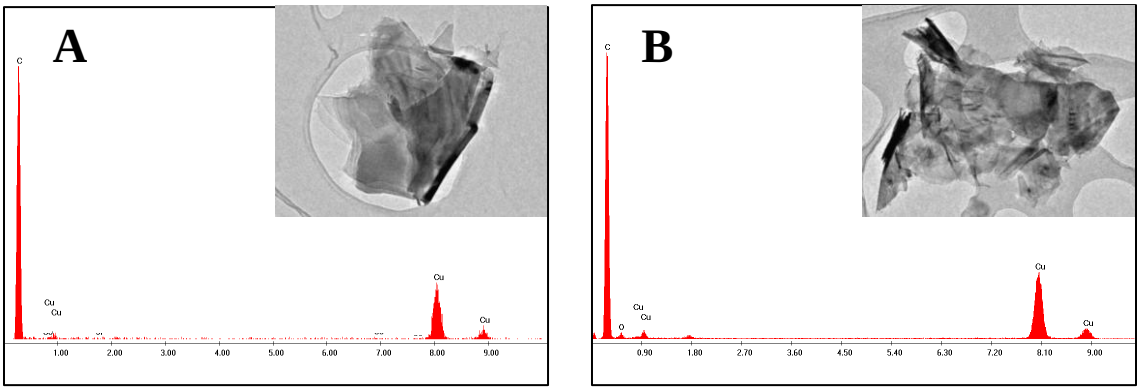

Fig. S3 EDX analyses of the TEM samples (inset) of used catalysts prepared with methane in the reduction step: A) U-H_2O and B) SC-EG (Cu peak is from the grid).

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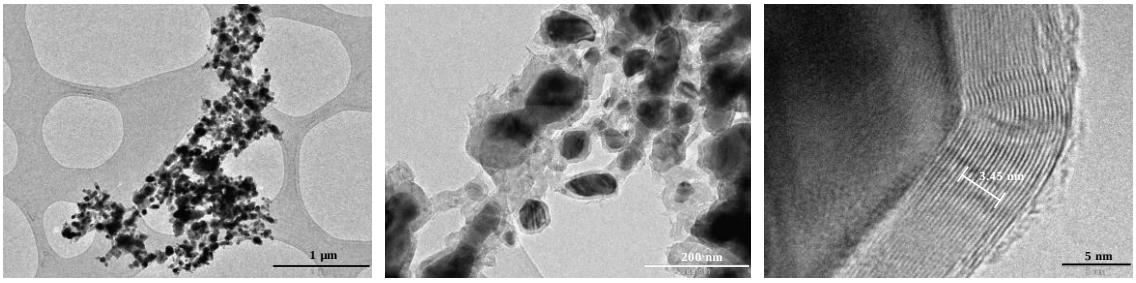

Fig. S4 HRTEM photograph of the used U-H_2O catalyst prepared using hydrogen in the reduction step.

Figure S4 presents the HRTEM image of the used U-H_2O catalyst after the decomposition reaction with pre-reduction with H_2. The catalyst shows only the formation of graphitic layers all over the catalysts which covering the cobalt metallic particles. The spacing between the neighboring sheets was measured to be 0.34 nm which is consistent with that between the (002) planes of graphite. Similar observation is also observed with the SC-EG catalyst with its pre-reduction with H_2. Therefore, the pre-treatment of the catalyst with H_2 does not facilitate the graphene formation over the catalysts.

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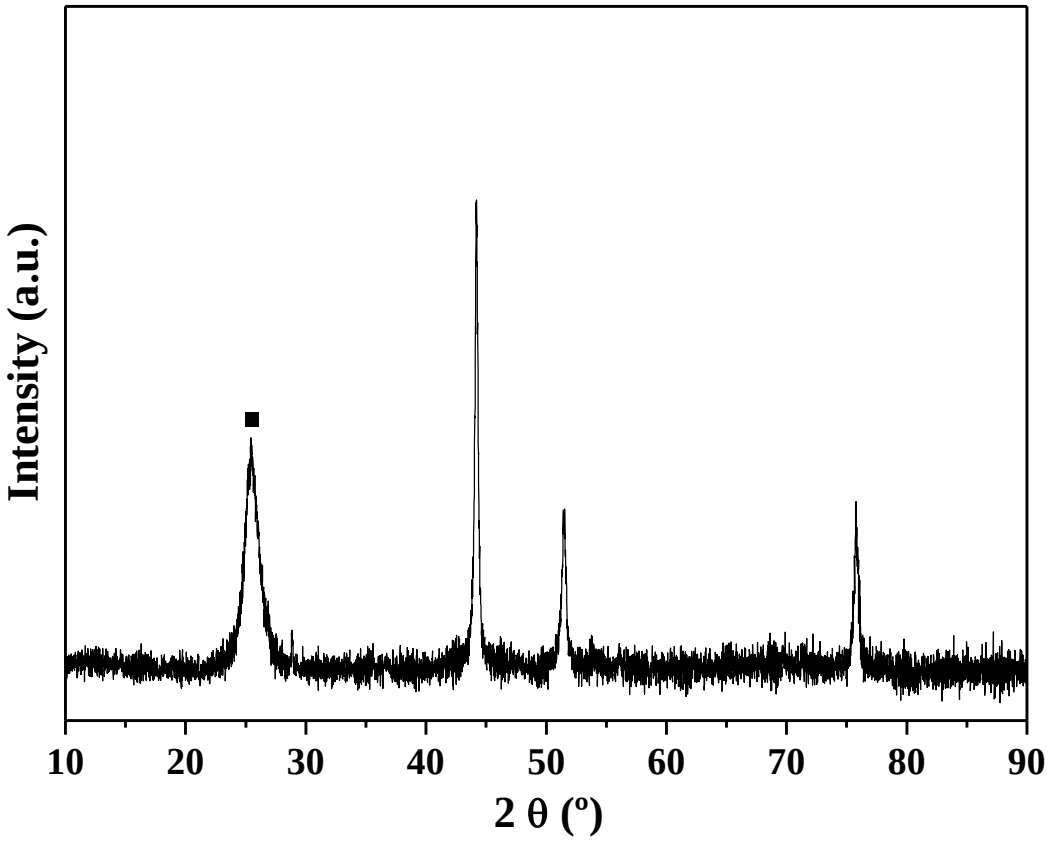

Fig. S5 XRD pattern of the used U-H_2O catalyst prepared using hydrogen in the reduction step. (marked peak is due to the carbon formed in the reaction).

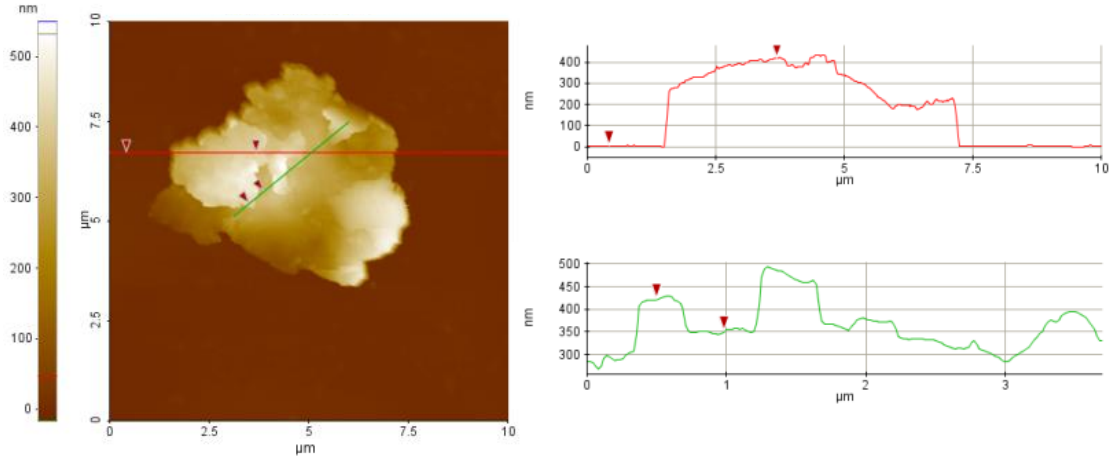

Fig. S6 AFM image of used U-H_2O catalyst, prepared using methane in the reduction step, along with the height histogram of the marked red and green lines.

Fig. S6 shows the topographic heights of the graphene layers over the used U-H_2O catalysts after the decomposition reaction, obtained with in presence of CH_4 during the reduction treatment. The thickness of the graphene layer is about 300-400 nm. This value indicates a quite higher edge roughness for this catalyst compared to that of SC-EG, which is only 2.5-10 nm.