Supporting Information for

Facile synthesis of Pd-Ir bimetallic octapods and nanocages through galvanic replacement and co-reduction, and their use for hydrazine decomposition‡

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The H_2 selectivity of a catalyst

Generally, hydrazine can be decomposed to generate a mixture of N_2 and H_2 (Eq. 1) or a mixture of NH_3 and N_2 (Eq. 2). The overall reaction is expressed as Eq. (3). Since the reaction according to Eq. (2) does not generate H_2, the H_2 selectivity, x, of a catalyst can be defined as the percentage of decomposition according to Eq. (1). When NH_3 is removed from the gas mixture, the H_2 selectivity can be calcualted from the amounts of N_2 and H_2 based on Eqs. (4) and (5).

$$N_2H_4 = N_2 + 2H_2 \quad (1)$$

$$3N_2H_4 = 4NH_3 + N_2 \quad (2)$$

$$3N_2H_4 = 4(1-x)NH_3 + (1+2x)N_2 + 6xH_2 \quad (3)$$

$$n(N_2+H_2)/n(N_2H_4)=[(1+2x) + 6x]/3 \quad (4)$$

$$x = [3n(N_2+H_2)/n(N_2H_4)-1]/8 \times 100\% \quad (5)$$

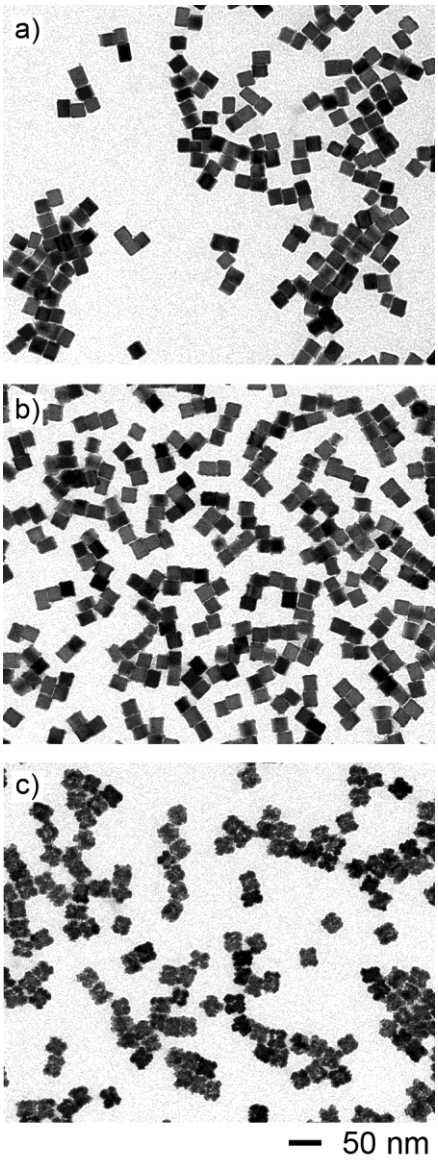

Fig. S1 TEM images of Pd-Ir bimetallic nanostructures obtained at different stages of a standard synthesis: a) 0.5 h, b) 1 h, and c) 9 h. The scale bar applies to all images.

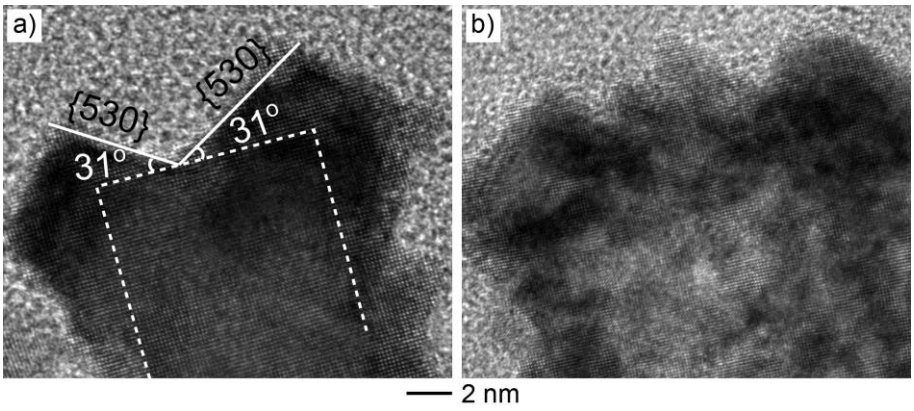

Fig. S2 High-resolution TEM images of the octapod and cage shown in Fig.2, c and d.

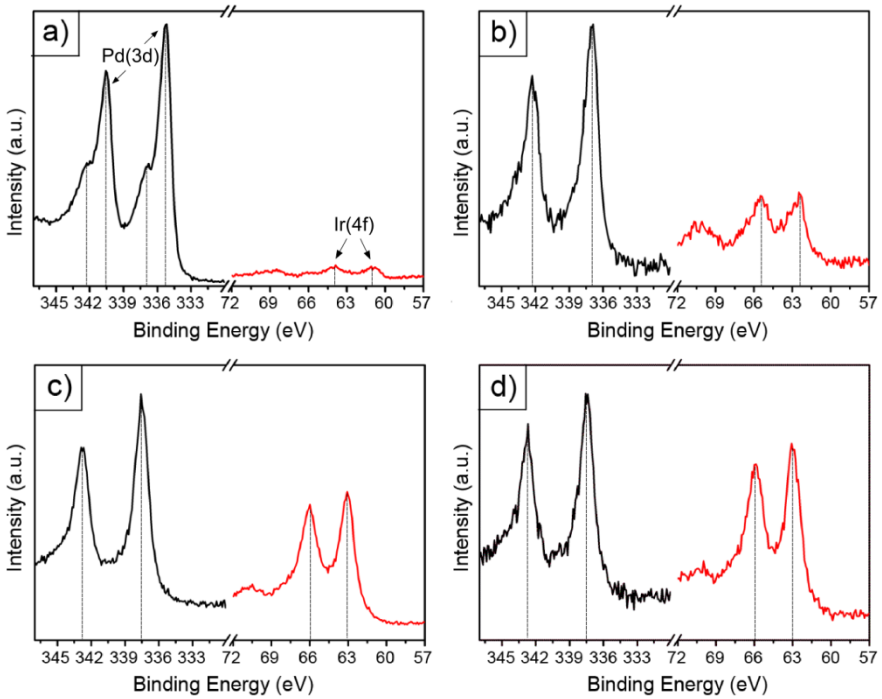

Fig. S3 X-ray photoelectron spectra (XPS) of Pd-Ir bimetallic nanostructures obtained at different stages of a standard synthesis: a) 1 h, b) 2 h, c) 9 h, and d) 24 h. Black and red curves correspond to elemental Pd and Ir, respectively.

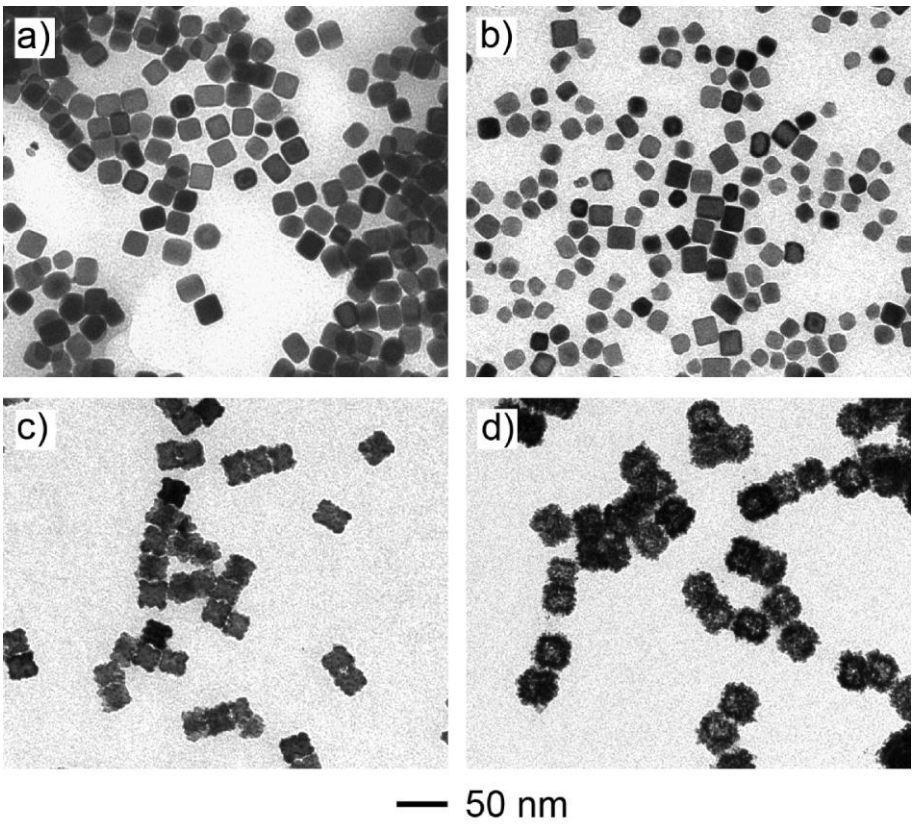

Fig. S4 TEM images of Pd-Ir bimetallic nanostructures obtained using the standard procedure, except that the reaction temperature was set to a, b) 100 ^{o}C and c, d) 160 ^{o}C, respectively. The products were obtained at different stages of the syntheses: a, c) 2 h and b, d) 24 h.

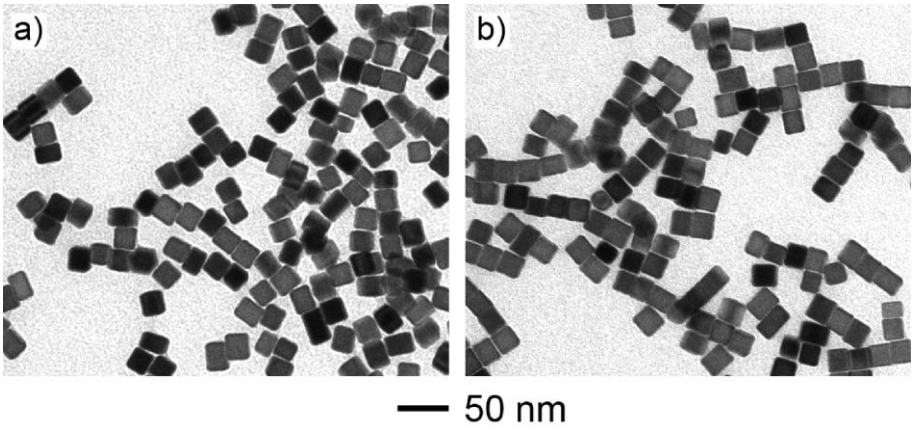

Fig. S5 TEM images of Pd nanostructures obtained from a standard synthesis, in which no Ir precursor was added. The samples were obtained at different stages of the same synthesis: a) 2 h and b) 24 h, respectively.

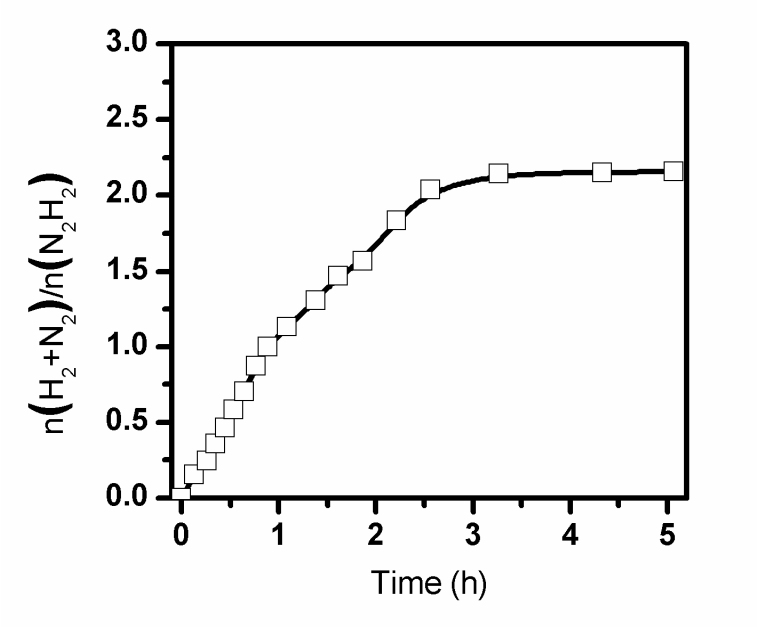

Fig. S6 Catalytic decomposition of hydrazine monohydrate to generate H_2 in the presence of 14-nm Pd-Ir nanocages as a catalyst.

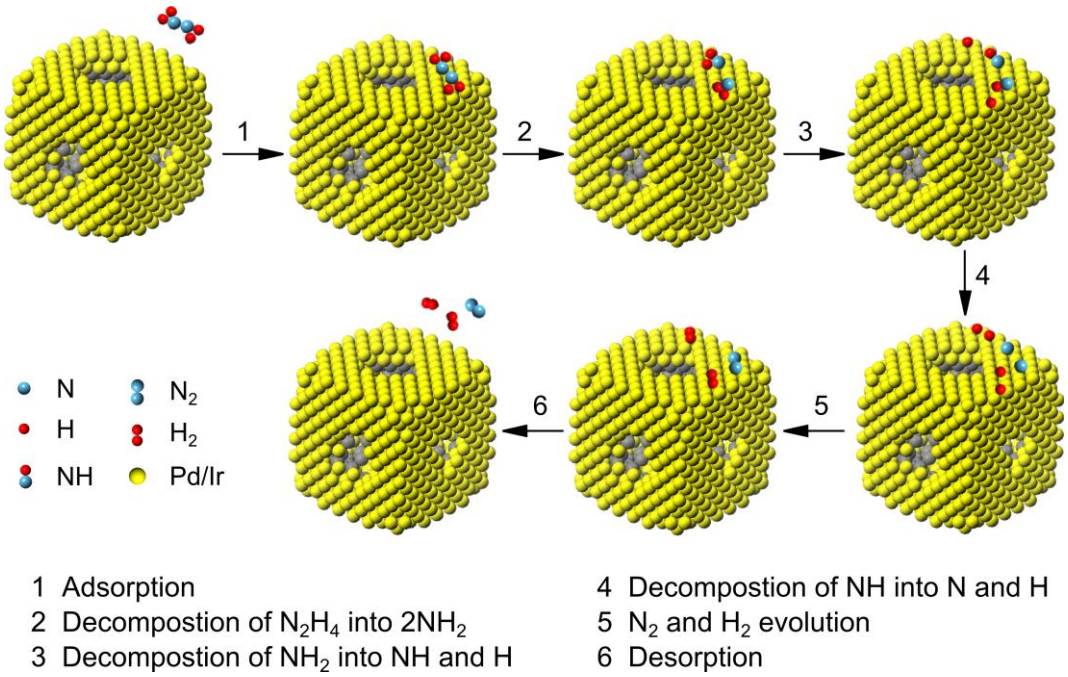

Fig. S7 A plausible mechanism involved in the decomposition of N_2H_4 over a Pd-Ir alloyed nanocage.