Supplementary information

Structure, optical and magnetic properties of Ni@Au and Au@Ni nanoparticles synthesized via non-aqueous approaches

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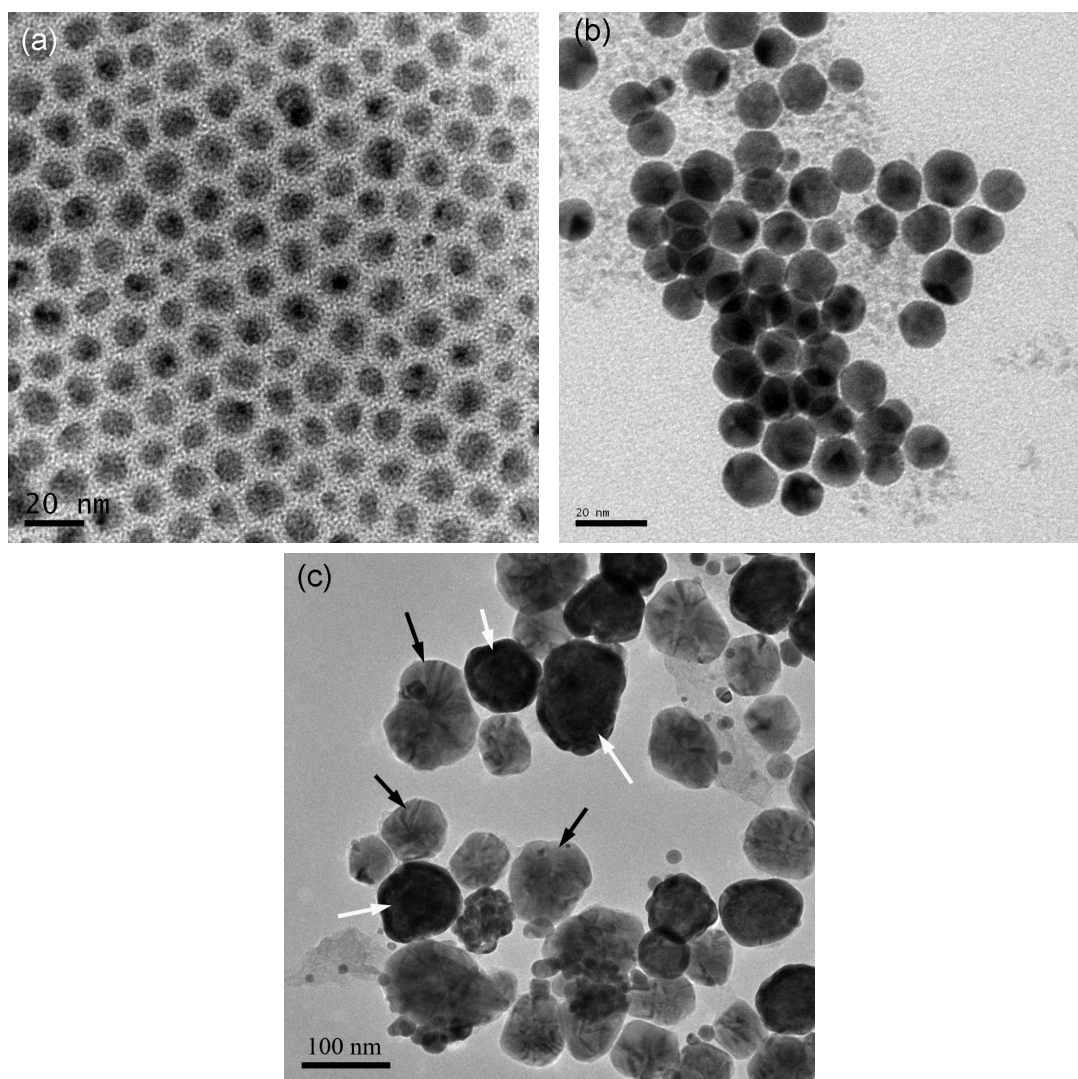University, Xiamen 361005, P. R. China.

Fig. S1 (a) TEM image of Ni core nanoparticles prepared at 195 ºC using HAuCl$_4$·4H$_2$O as the promoting agent. Note that no Au precursor was injected in the followed step to coat Ni. (b) TEM image of the products prepared at 195 ºC without using HAuCl$_4$·4H$_2$O as the promoting agent for the formation of Ni cores. Ni core nanoparticles with well defined shapes are not formed at this temperature and the spherical nanoparticles in the TEM image are Au nanoparticles. (c) TEM image of the products prepared at 220 ºC without using HAuCl$_4$·4H$_2$O as the promoting agent for the formation of Ni cores. The products consist of a mixture of big Ni nanoparticles (indicated by black arrows) and Ni@Au nanoparticles (indicated by white arrows). The particle morphology is not well controlled and only part of Ni nanoparticles can be coated with Au shell.
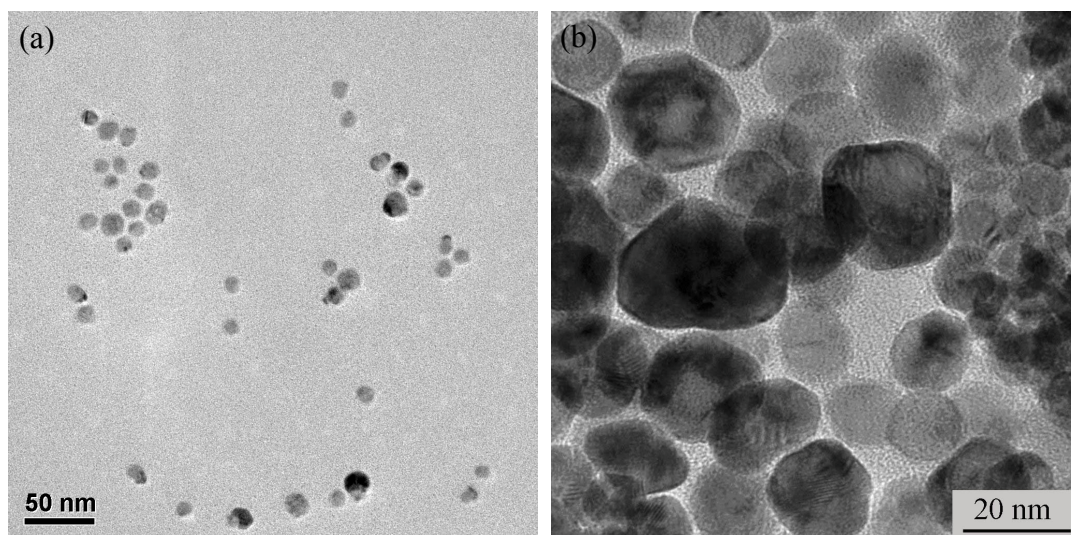
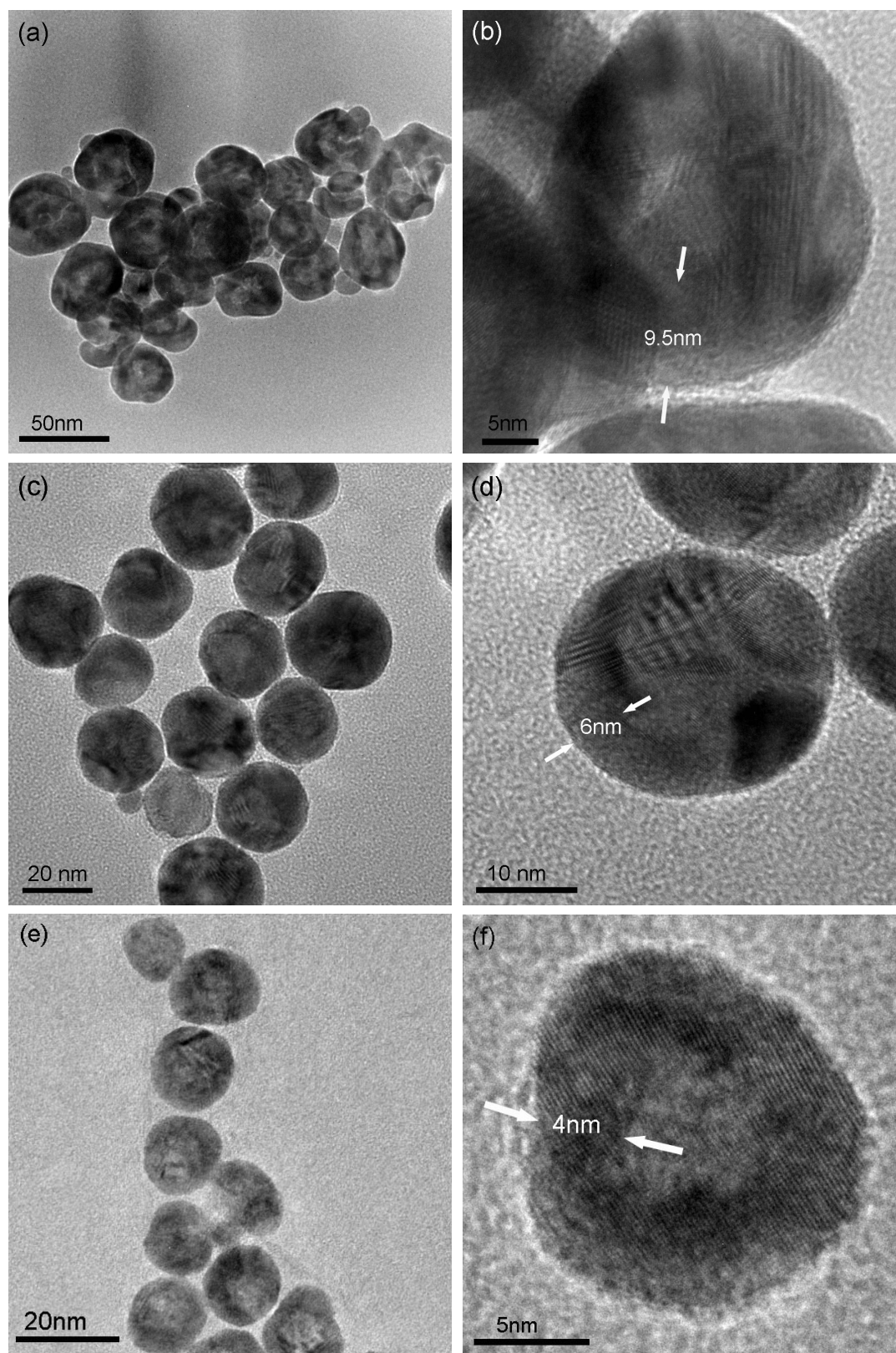Fig. S2 TEM images of the products prepared by injection of 0.1 g (a) and 0.15 g (b) of Au precursor.

Fig. S3 Low-magnification ((a), (c) and (e)) and high-resolution ((b), (d) and (f)) TEM images showing the shell thickness variation (indicated in (b), (d) and (f)) of Ni@Au nanoparticles synthesized at different conditions. (a) and (b) correspond to the products obtained using 0.4 g of Au precursor. (c) and (d) correspond to the products obtained using 0.3 g of Au precursor. (e) and (f) correspond to the products obtained at a nucleation temperature of 180 ºC for Ni cores. All other conditions are fixed with reference to the typical synthesis.
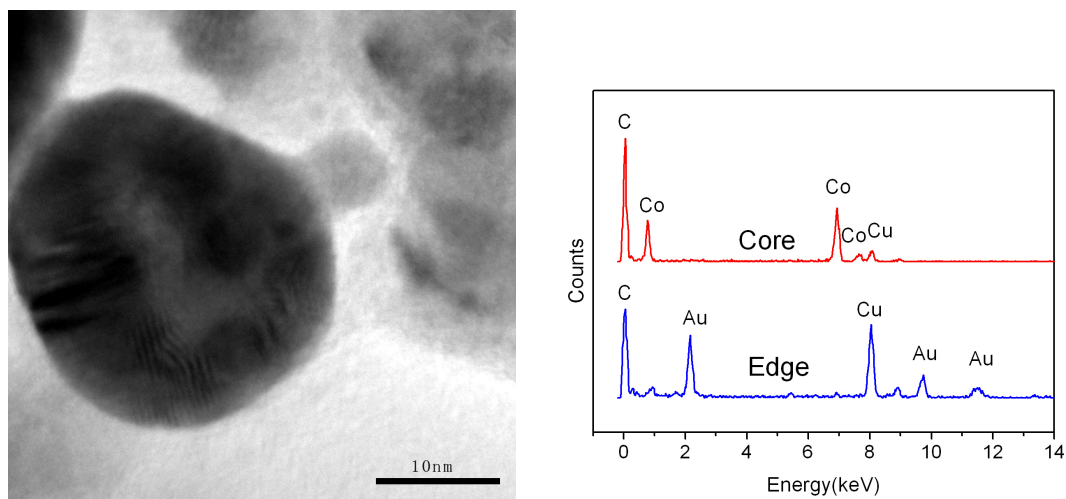
Fig. S4 TEM image (a) and EDS spectra (b) of Co@Au nanoparticles synthesized using similar method to that of Ni@Au nanoparticles. The employed magnetic metal precursor is $Co(acac)_2$.
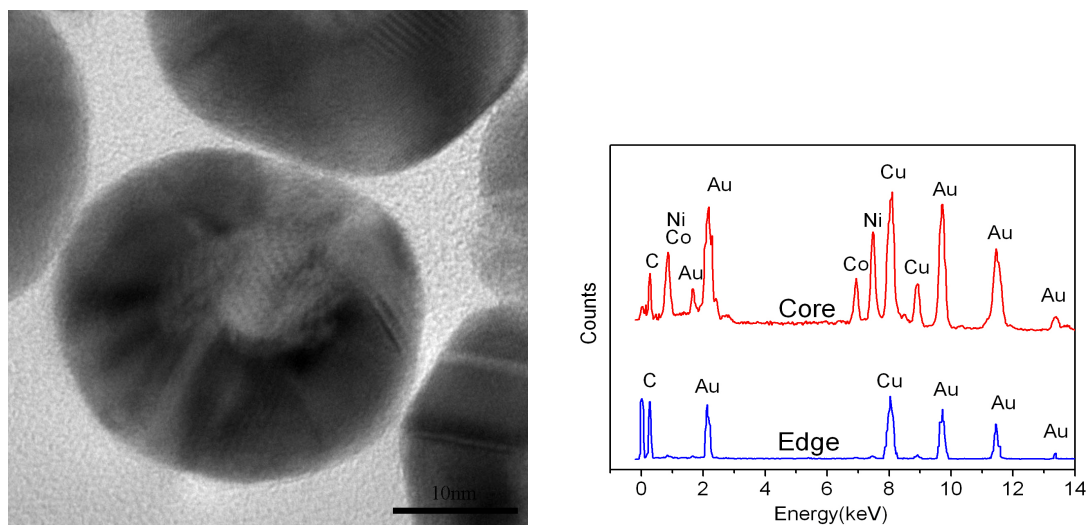

Fig. S5 TEM image (a) and EDS spectra (b) of CoNi@Au nanoparticles synthesized using similar method to that of Ni@Au nanoparticles. The employed magnetic metal precursors are $Ni(acac)_2$ and $Co(acac)_2$.
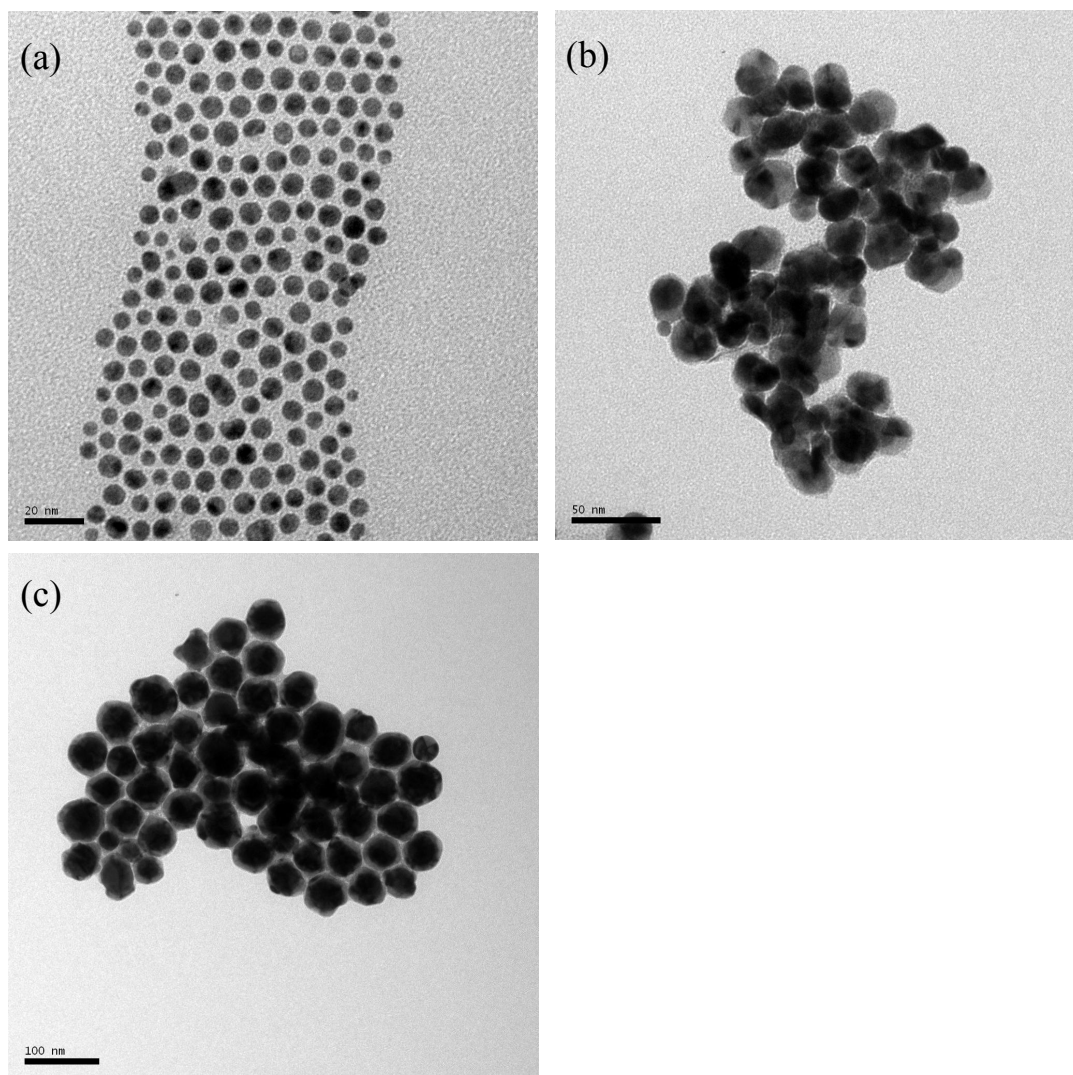
Fig. S6 TEM images of the products prepared using different amounts of TPP in the syntheses of Au@Ni nanoparticles. (a) 0 mmol of TPP; (b) 0.2 mmol of TPP; (c) 0.9 mmol of TPP. Note that only nanoparticles shown in (c) have complete core-shell structure.
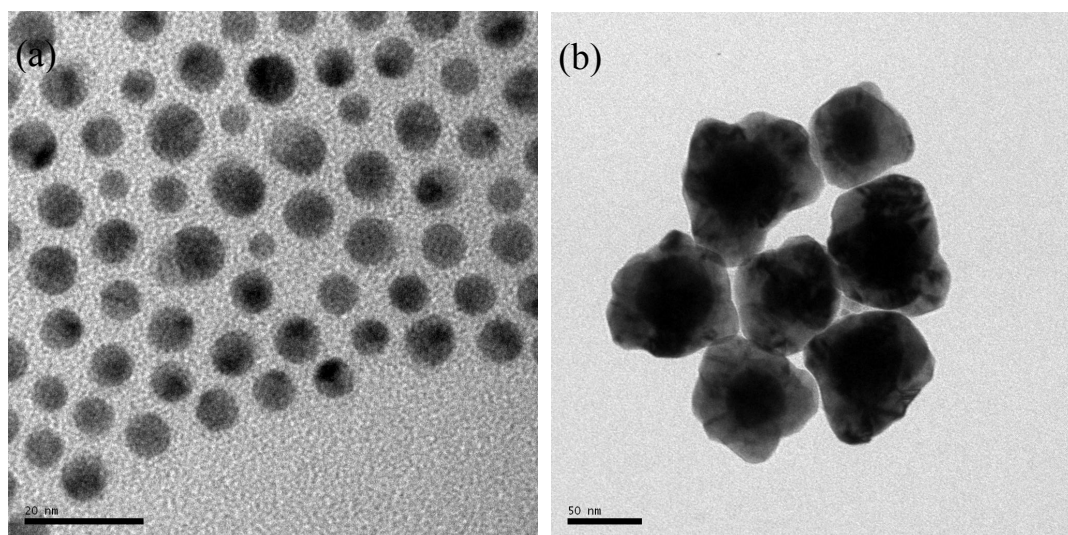
Fig. S7 TEM images of the products synthesized using different amounts of HAuCl$_4$·4H$_2$O in the syntheses of Au@Ni nanoparticles (the quantity of TPP is kept at 0.3 mmol). (a) 0.25 mmol; (b) 0.05 mmol.
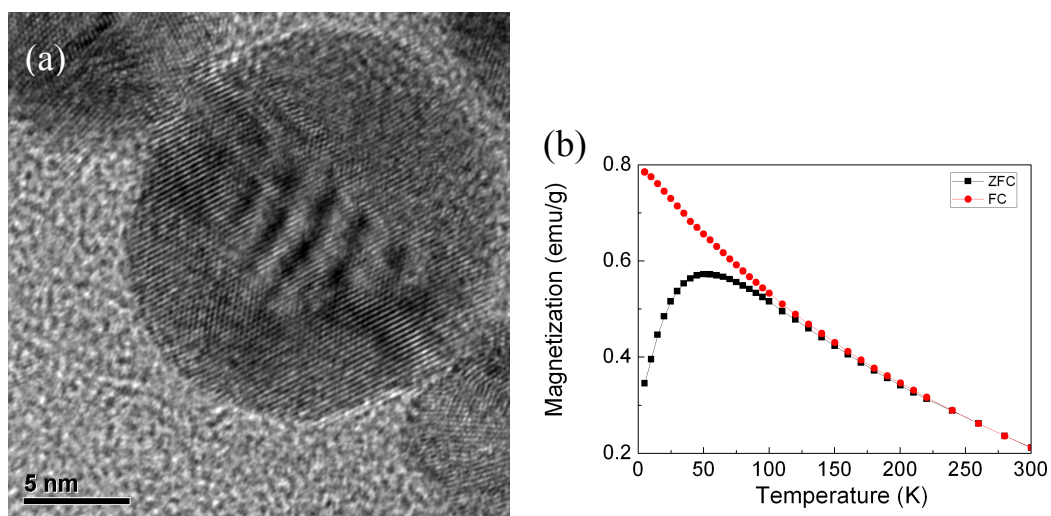

Fig. S8 HRTEM image (a) and ZFC/FC curves (b) of Ni@Au nanoparticles with a relative small size (~11 nm) Ni core.