Supporting Information

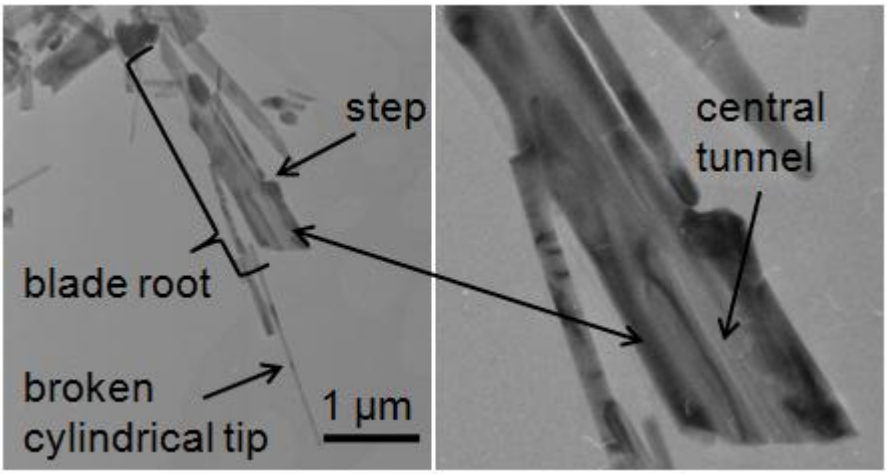

Figure S1 TEM image of a blade-like bicrystal nanoflake base and a cylindrical single crystal nanoflake tip that likely broke from the parent blade-like nanoflake during sample preparation. The blade-like nanoflakes taper gradually and also in abrupt steps. At the base of the nanoflake shown, a central tunnel, much like those imaged by Voss *et al.*,[26] is observed.

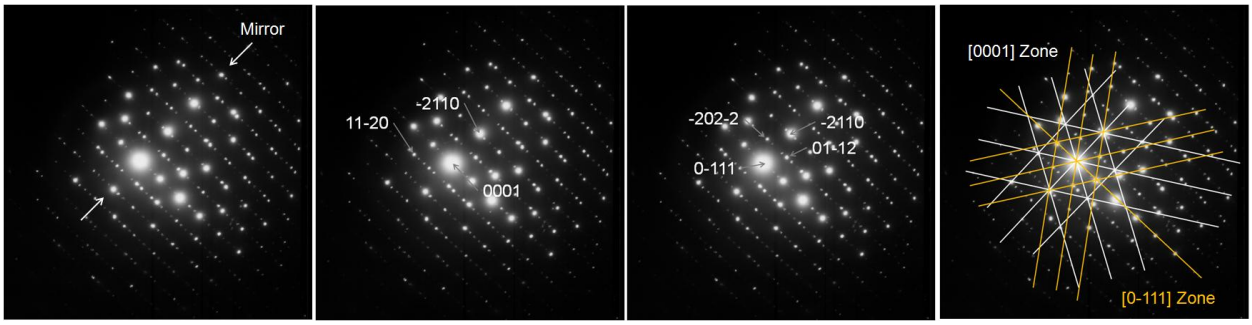

Figure S2 SAD pattern from the base of a single α-Fe_2O_3 nanoflake grown at 800 °C in the post-flame region. The pattern shows an apparent mirror plane and, when indexed, resolves into two complete, coincident zones, the [0001] and the [$0\bar{1}11$], with a common ($\bar{2}110$) reflection. This is the same nonstructural twin identified by Voss *et al.*,[26] with twin plane ($01\bar{1}1$) and shear direction [$0\bar{1}$ 12]. The axial growth direction in these twinned "bicrystal" nanoflakes was found to be <$11\bar{2}0$> type, or $<110>_{hex.}$ These twinned nanoflakes have a broad side formed by the {$\bar{1}101$} or $\{\bar{1}11\}_{hex}$ type planes, as a consequence of the twin plane.

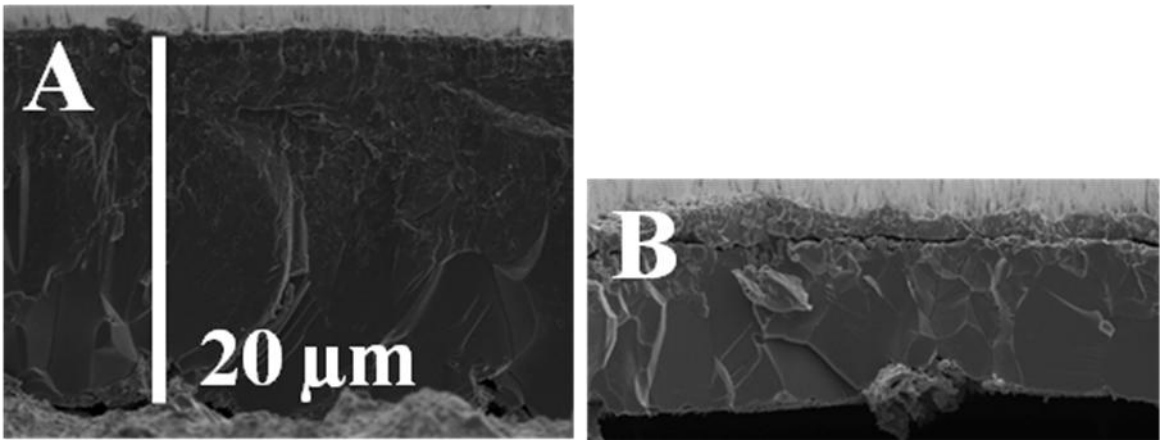

Figure S3 α-Fe_2O_3 nanoflakes were grown in a tube furnace for 20 minutes at 700 °C with 5 SLPM air flow and (A) a small heating rate of approximately 100 ºC/min and (B) a large heating rate of 1400 ºC/min. The resulting total oxide layers are shown here, with both images to the same scale.

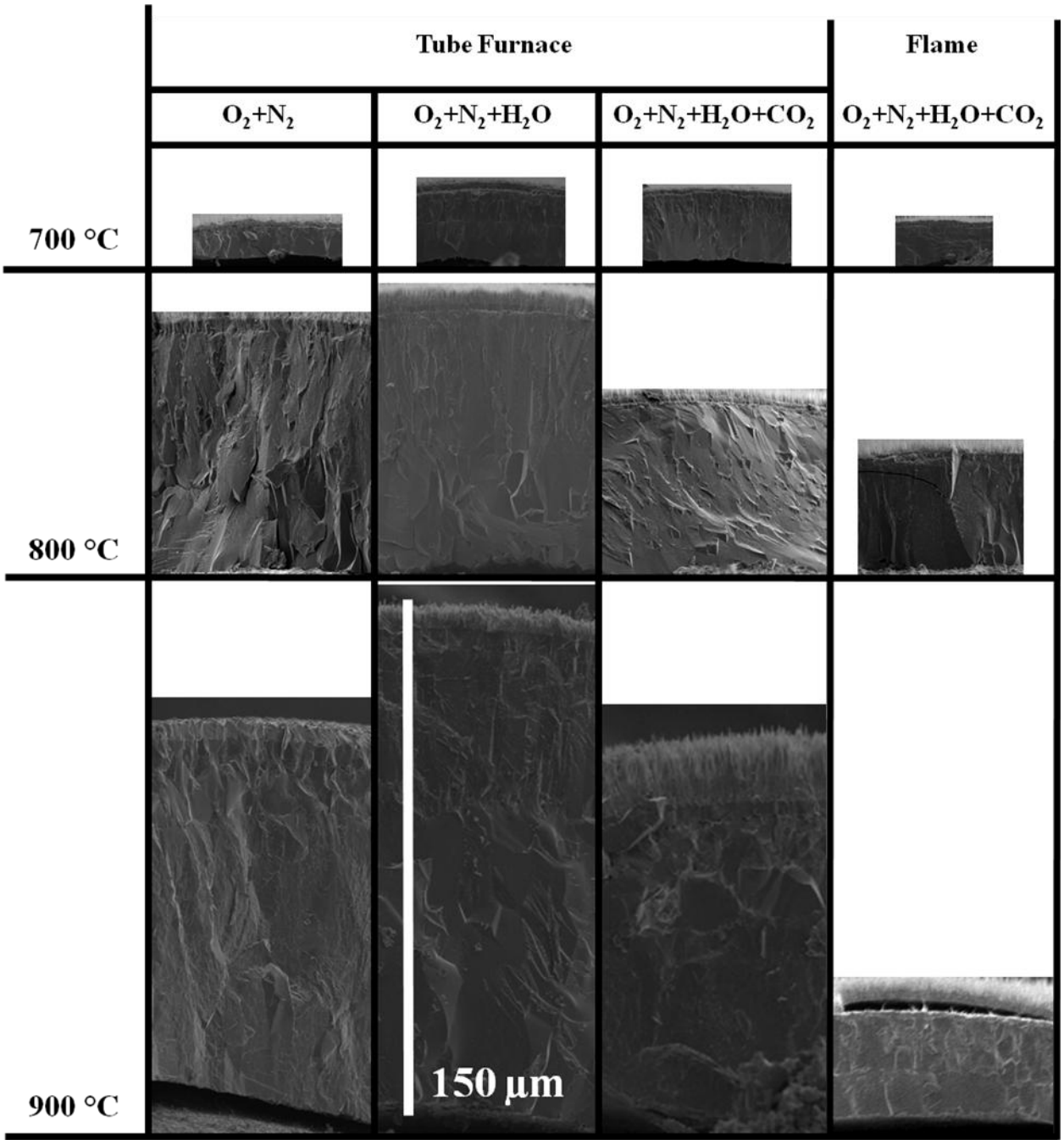

Figure S4 α-Fe_2O_3 nanoflakes were grown in a tube furnace for 20 minutes at 700, 800 and 900 °C with gas phase compositions including air (O_2 + N_2), air and water vapor (O_2 + N_2 + H_2O) and air, water vapor and carbon dioxide (O_2 + N_2 + H_2O + CO_2). The resulting total oxide layers are shown here, with all images to the same scale.