

Preparation of rare-earth doped NaYF₄ luminescent nanoparticles by high-energy ball milling process

Electronic Supplementary Information

Aleksandr V. Koshelev^{*a}, Vadim V. Grebenev^a, Natalia A. Arkharova^a,
Andrey A. Shiryayev^b, Denis N. Karimov^{*a}

^aFSRC “Crystallography and Photonics” of Russian Academy of Sciences, 59,
Leninskiy Prospekt, Moscow, 119333, Russia.

^bInstitute of Physical Chemistry and Electrochemistry of Russian Academy of
Sciences, 31, Leninskiy Prospekt, Moscow, 119071, Russia

e-mail: avkoshelev03@gmail.com (A.V. Koshelev)

dnkarimov@gmail.com (D.N. Karimov)

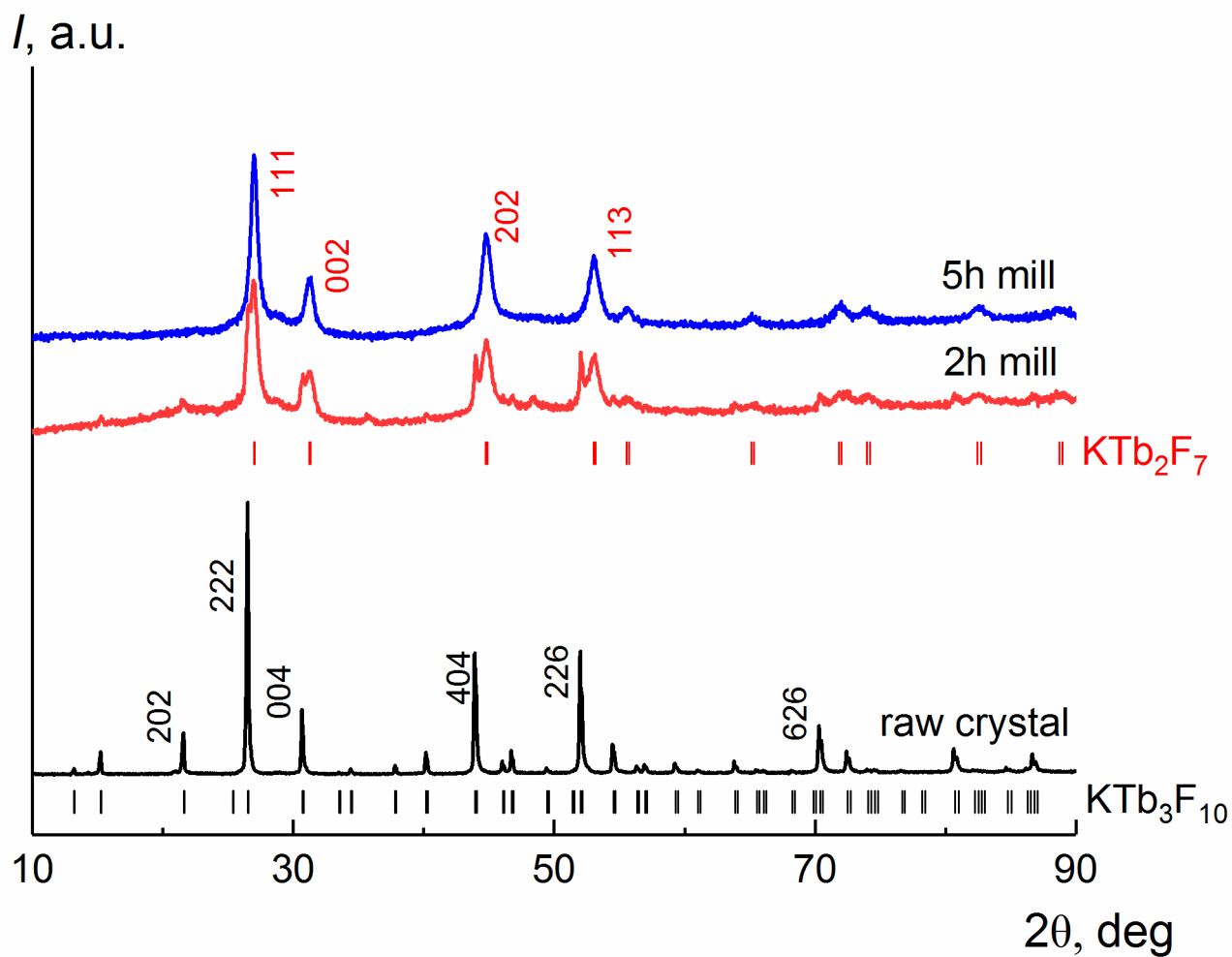


Figure S1 XRD patterns $\text{KTb}_3\text{F}_{10}$ crystal after different “wet” mechanical milling treatment; the positions of the Bragg peaks for the $\text{KTb}_3\text{F}_{10}$ (ICDD PDF 01-074-2165, sp. gr. $Fm\bar{3}m$) and KTb_2F_7 (ICDD PDF 00-057-0574, sp. gr. $Fm\bar{3}m$) are indicated.

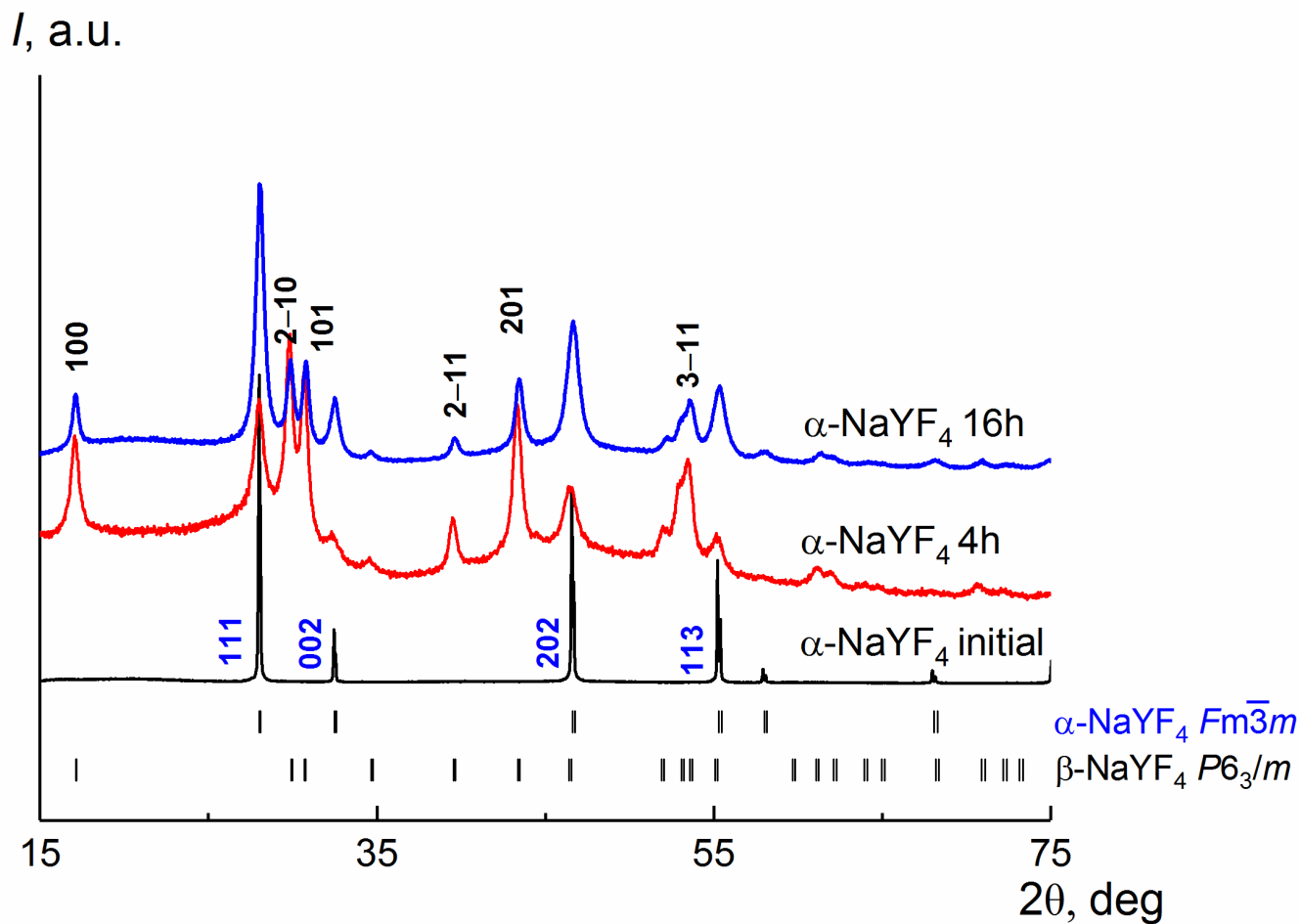


Figure S2 XRD patterns of the “wet” milled α - NaYF_4 crystals at different duration of mechanical treatment. The positions of the Bragg peaks for sp. gr. $Fm\bar{3}m$ (ICDD PDF 01-077-2042) and $P6_3/m$ (ICDD PDF 00-064-0156) are indicated.

FTIR analysis

FTIR spectra of the oleic acid, «dry»-milled β -NaYF₄ and oleate-capped 16 h-milled β -NaYF₄ NPs were measured on a Bruker Alpha FTIR spectrometer using the KBr method. The spectra in transmission mode were recorded in a wavenumber range of 4000-500 cm⁻¹.

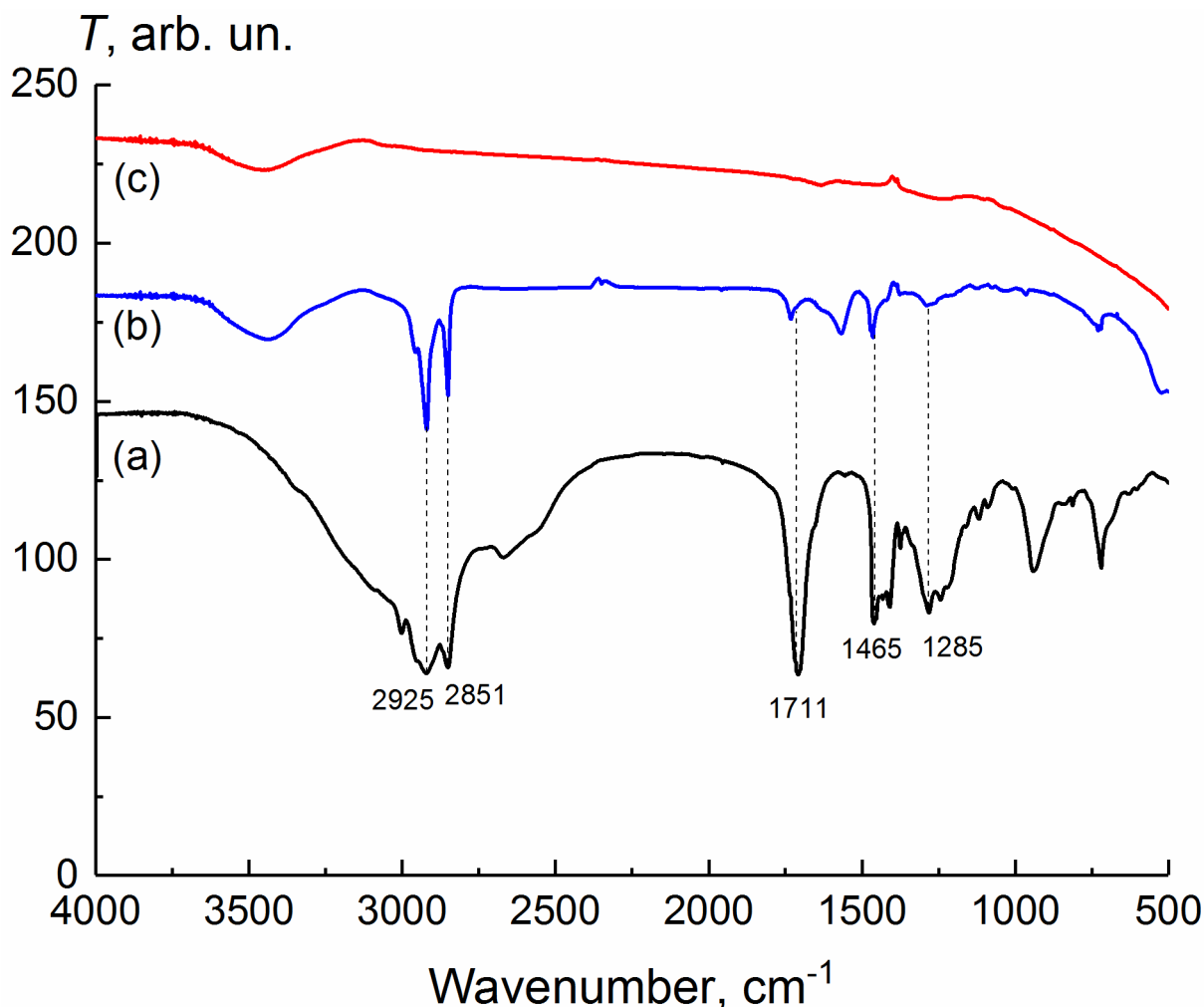


Figure S3. FTIR spectra of (a) pure oleic acid, (b) β -NaYF₄ NPs, produced *via* 16 h oleate-mediated milling, and (c) «dry»-milled (oleate-free) β -NaYF₄ NPs.

The signals, observed for pure oleic acid, are corresponded to the characteristic vibrations of various functional groups: -CH_{val} and $\text{-COO-H}_{\text{val}}$ (3150-2800 cm⁻¹), -C=O (1711 cm⁻¹), -CH_{def} and -COO_{def} (1480-1400 cm⁻¹). In the FTIR spectrum of β -NaYF₄ NPs, fabricated by 16 h oleate-mediated milling, analogous peaks are observed, confirming the functionalization of the NPs surface by oleic acid molecules.