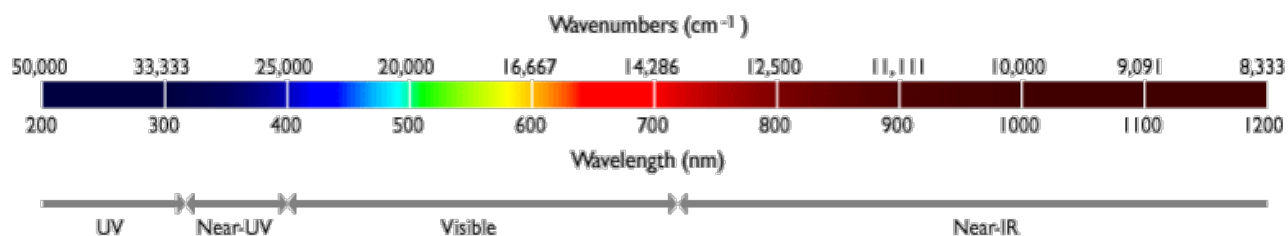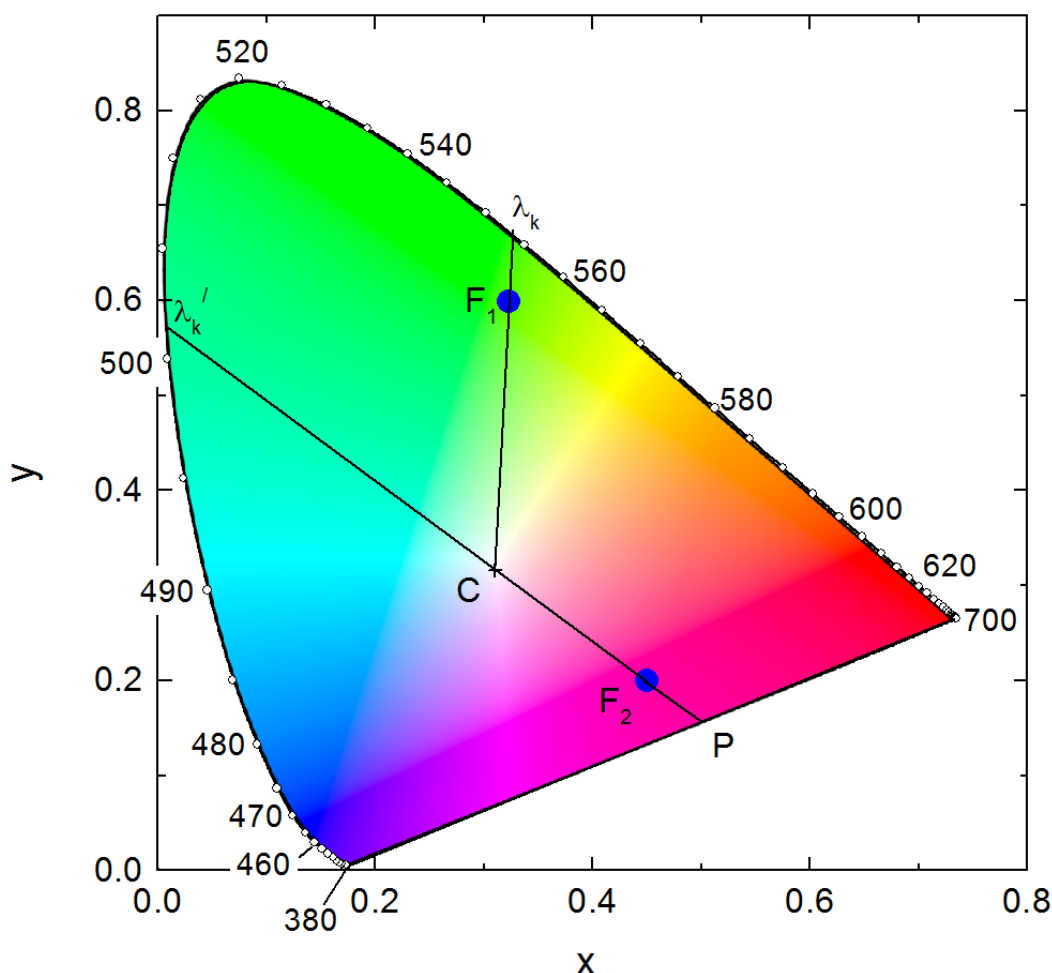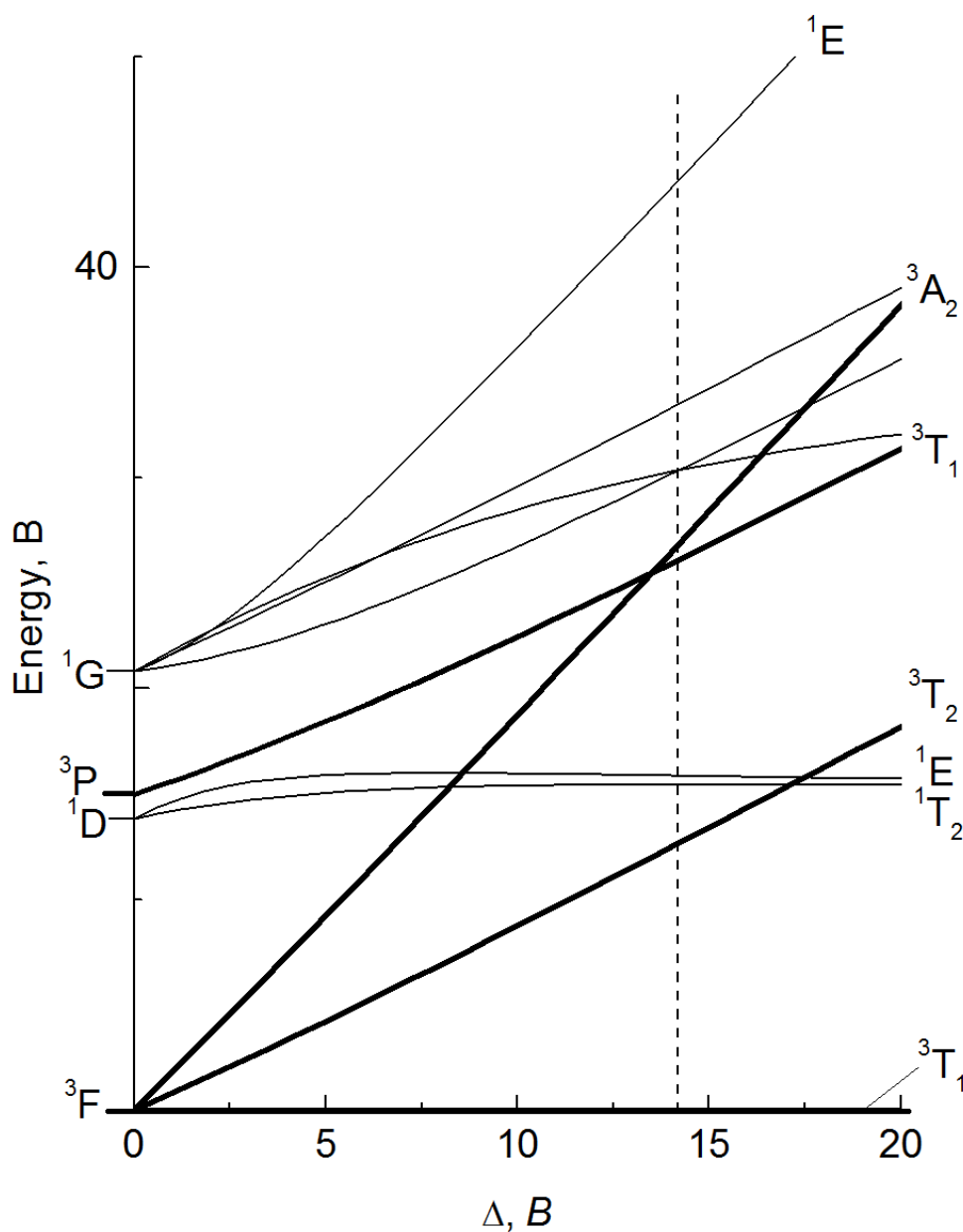**Supplementary Figures**

Supplementary Fig. S1. Photo of 12 gahnite crystals after the first stage of preparation (grinding and polishing on both sides to a thickness of about 1 mm), still glued on the surface of a glass plate with epoxy. At a later time, for spectroscopic measurements the samples were detached from the glass plate and cleaned from epoxy, some crystals were re-polished, decreasing the thickness (see Table 1), which was done to allow improved spectroscopic measurement recordings. Four additional samples (Ghn-3, Gh-9, Gh-12 and Gh-13) were likewise prepared and investigated.

Supplementary Fig. S2. The UV-VIS-NIR regions of the electromagnetic spectrum

(https://researchguides.library.wisc.edu/c.php?g=241913&p=1611659).

Supplementary Fig. S3. The CIE 1931 color space chromaticity diagram describing the dominant wavelength, λ_k, for the spectral colors and the supplementary wavelength, λ_k', for purple colorations. The boundary curve is the spectral (or monochromatic) locus with wavelengths shown in nanometers. The straight line gives the loci of the most saturated purple colors consisting of mixtures of red and blue light. Here, there is no appropriate monochromatic λ_k value and, therefore, the value of the supplementary spectral color λ_k' is used.

Supplementary Fig. S4. Tanabe-Sugano diagram for the electronic d^2 configuration. The dashed line

represents $^{IV}Ni^{2+}$ in spinel $MgAl_2O_4$ with a crystal field splitting of $\Delta = 5040$ cm^{-1} and the Racah

parameter $B = 356$ cm^{-1}. The energy of the $^3T_1$ (^3F) → $^3A_1$ (^3F) transition of 9548 cm^{-1} is slightly

greater than that of $^3T_1$ (^3F) → $^3T_1$ (^3P) of 9300 cm^{-1}. The three levels $^3T_1$, $^3T_2$ and $^3A_2$ are shown by

bold lines because they have maximum triplet spin-multiplicity. Electronic transitions between them

are spin allowed.
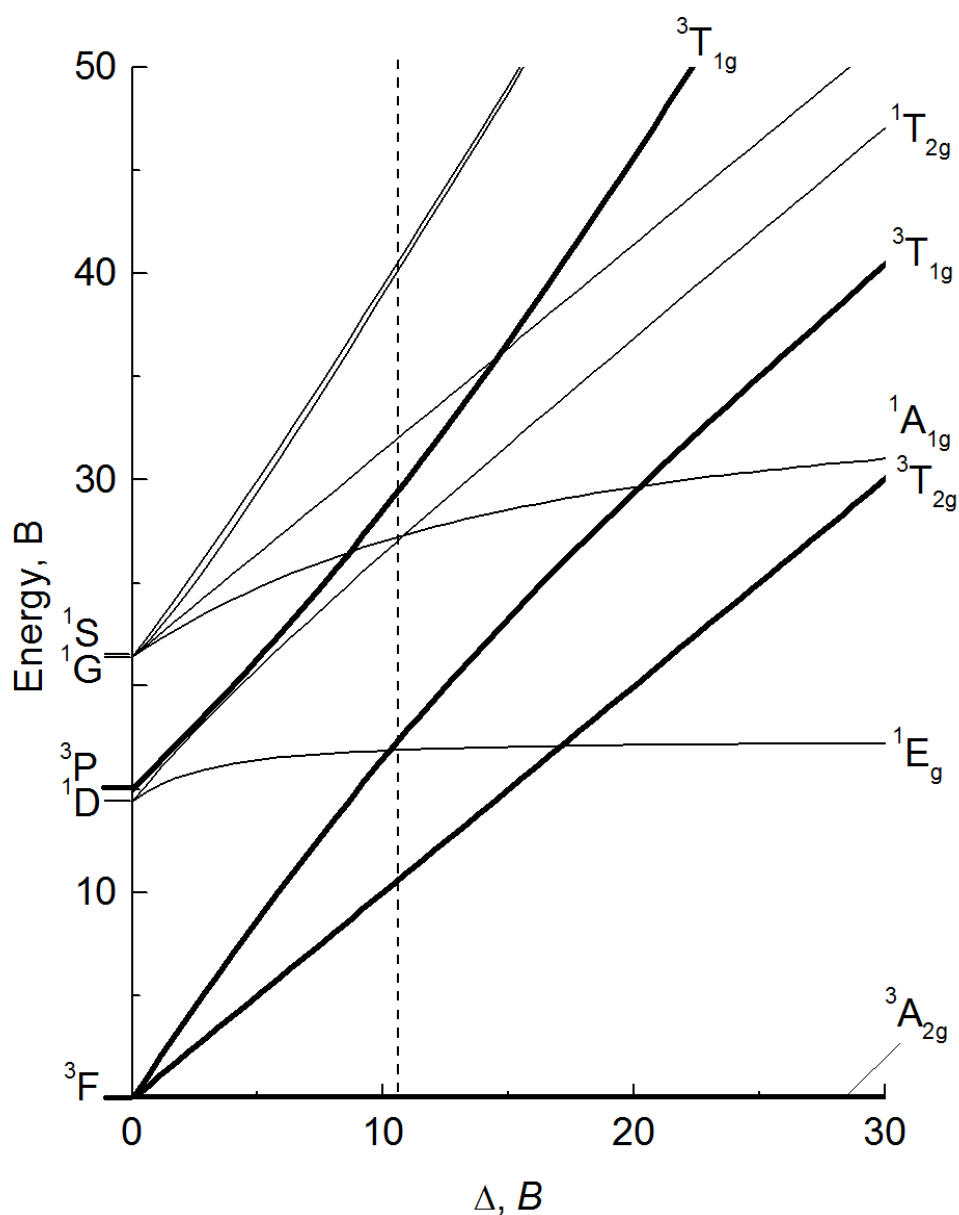
Supplementary Fig. S5. Tanabe-Sugano diagram for the electronic d^8 configuration. The dashed line

represents $^{VI}Ni^{2+}$ in spinel $MgAl_2O_4$ with a crystal field splitting of $\Delta = 9800$ cm^{-1} and the Racah

parameter $B = 907$ cm^{-1}. The calculated energy of the spin-allowed transition $^3A_{2g} \rightarrow {}^3T_{1g}$ (^3P) is

27009 cm^{-1}. The three levels $^3A_{2g}$, $^3T_{2g}$ and $^3T_{1g}$ are shown by bold lines because they have

maximum triplet spin-multiplicity. Electronic transitions between them are spin allowed.
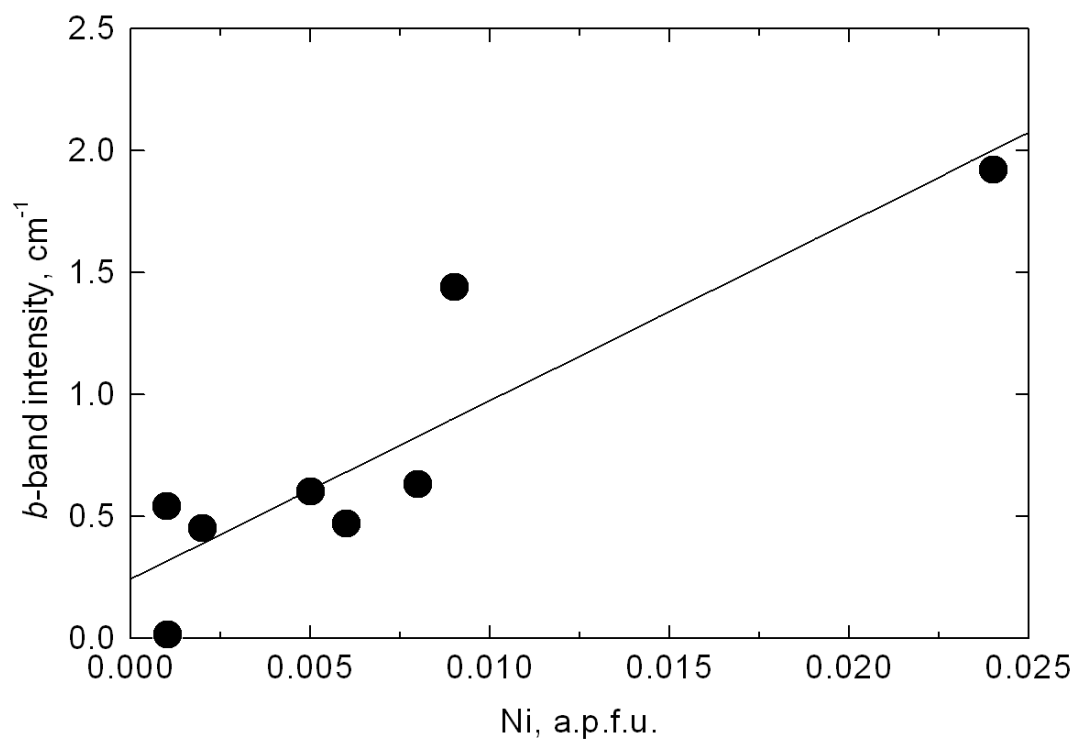
Supplementary Fig. S6. Intensity of band *b* as a function of nickel content per-formula-unit for gahnites Ghn-2 to Ghn-9 (Table 1). The line is a linear least-squares best fit to the data.

Supplementary Table S1. Chromaticity coordinates for various synthetic gahnites.

Sample	Chromaticity coordinates			
	x	y	λ_k	p_c
Ghn-2	0.306	0.318	497	0.013
Ghn-3	0.307	0.283	555'	0.127
Ghn-4	0.321	0.293	519'	0.113
Ghn-5	0.298	0.268	561'	0.173
Ghn-6	0.335	0.298	500'	0.118
Ghn-7	0.316	0.298	528'	0.082
Ghn-8	0.325	0.295	508'	0.115
Ghn-9	0.322	0.302	505'	0.080
Ghn-10	0.266	0.280	480	0.186
Ghn-11	0.262	0.276	480	0.206
Ghn-12	0.358	0.373	575	0.281
Ghn-13	0.367	0.383	575	0.332
Ghn-14	0.398	0.416	576	0.502
Ghn-15	0.317	0.334	566	0.065
Ghn-16	0.331	0.388	563	0.251
Galaxite	0.400	0.440	573	0.574

' – supplementary predominant wavelength for purple colors that do not have monochromatic spectral analogous.