Persistent luminescence of tenebrescent $Na_8Al_6Si_6O_{24}(Cl,S)_2$: multifunctional optical markers

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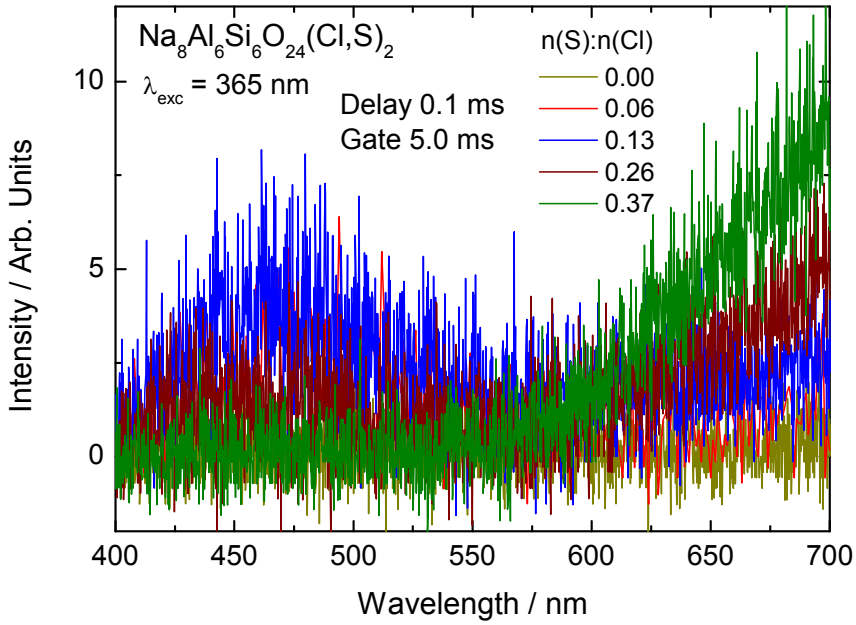

Figure S1. UV excited luminescence spectra of $Na_8Al_6Si_6O_{24}(Cl,S)_2$ with 365 nm excitation.

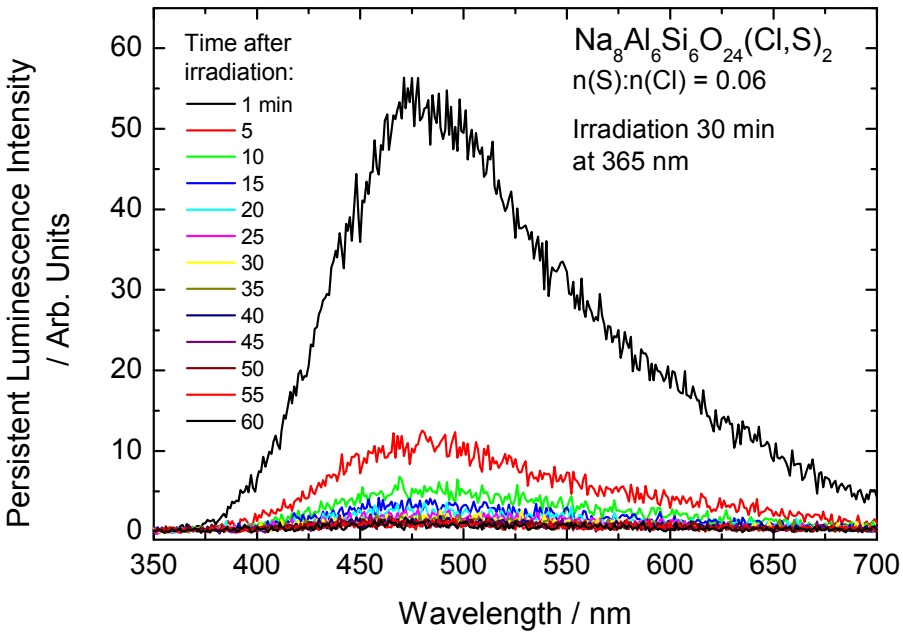

Figure S2. Persistent luminescence spectra of $Na_8Al_6Si_6O_{24}(Cl,S)_2$ with n(S):n(Cl) = 0.06 after ceasing 365 nm excitation.

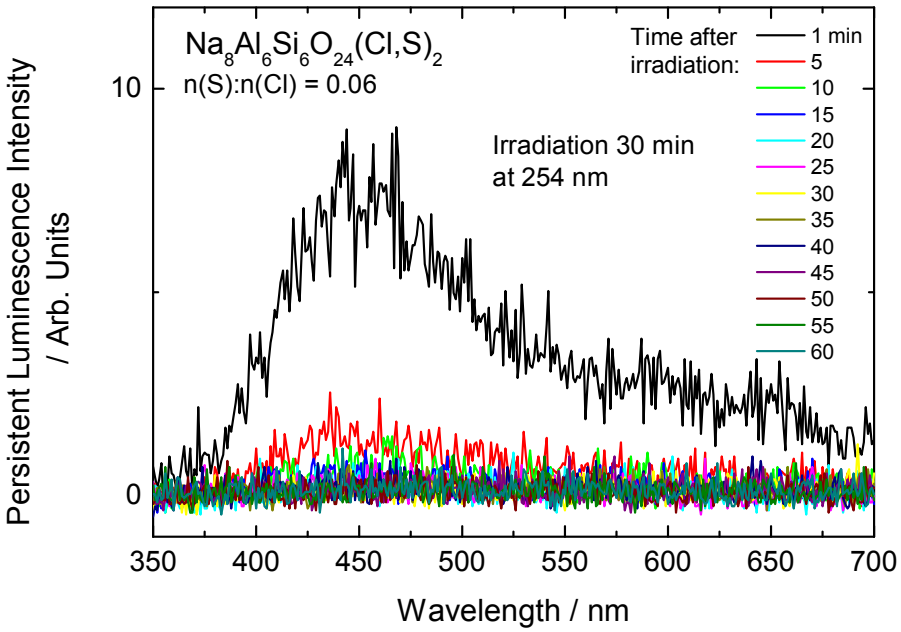

Figure S3. Persistent luminescence spectra of $Na_8Al_6Si_6O_{24}(Cl,S)_2$ with n(S):n(Cl) = 0.06 after ceasing 254 nm excitation.

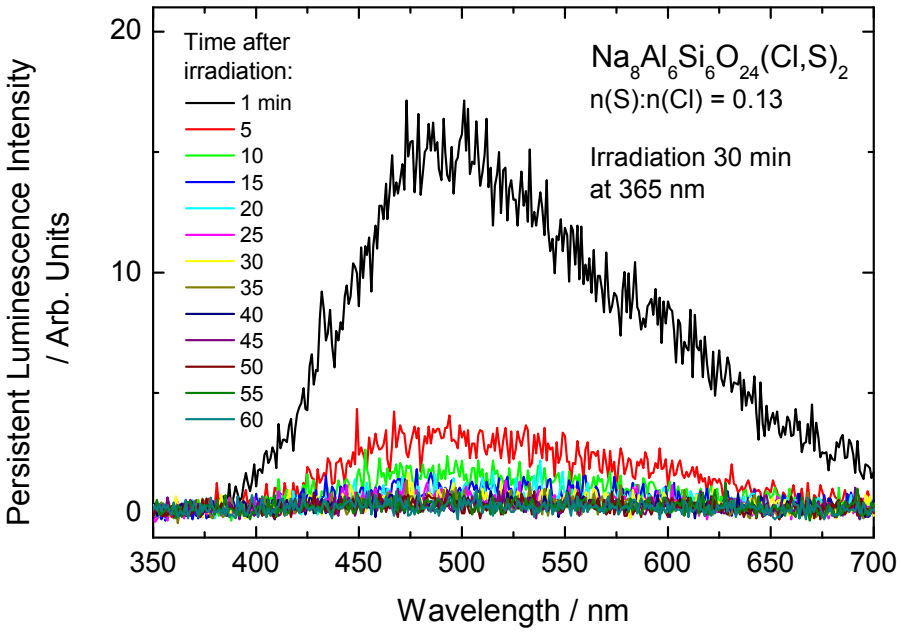

Figure S4. Persistent luminescence spectra of $Na_8Al_6Si_6O_{24}(Cl,S)_2$ with n(S):n(Cl) = 0.13 after ceasing 365 nm excitation.

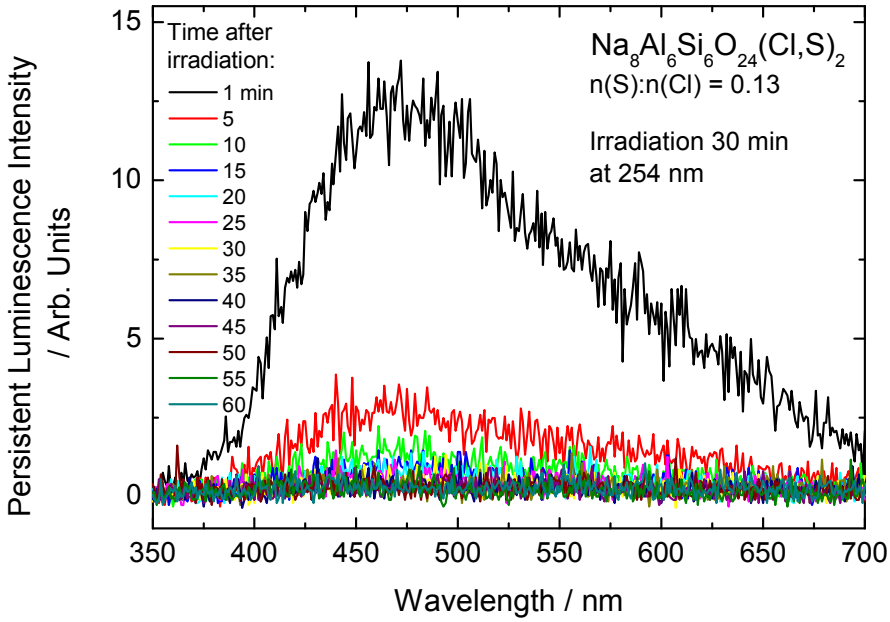

Figure S5. Persistent luminescence spectra of $Na_8Al_6Si_6O_{24}(Cl,S)_2$ with n(S):n(Cl) = 0.13 after ceasing 254 nm excitation.

Table S1. Contents of the starting materials NaCl and Na_2SO_4 as given by the manufacturers.

Elements	Content / %	Elements	Content / %
NaCl	min 99.5	**Na_2SO_4**	min. 99
Ba	max. 0.002	Cl	max. 0.0005
Br	max. 0.01	PO_4	max. 0.002
Ca	max. 0.002	N	max. 0.0005
Insoluble matter	max. 0.005	Pb	max. 0.0005
I	max. 0.005	Fe	max. 0.001
Mg	max. 0.001	As	max. 0.0001
K	max. 0.005	Ca	max. 0.002
SO_4	max. 0.005	K	max. 0.002
As	max. 0.0003		
Pb	max. 0.0005		
Fe	max. 0.0003		
PO_4	max. 0.0005		

Table S2. Contents of the zeolite starting material as obtained with XRF.

Elements	Content / %	Elements	Content / %
Si	48.6	Mn	0.01
Al	34.3	Fe	0.04
Na	16.2	Ti	0.03
Cl	0.66	Ca	0.03
K	0.10	S	0.01

To be sure that the luminescence and/or tenebrescence properties were not due to the NaCl impurity, we washed our samples in distilled water to remove excess of NaCl. The diffraction pattern showed the absence of NaCl reflections (Fig. S6). After purifying the samples all of them show the same behavior (tenebrescence, persistent luminescence and UV excited luminescence) and due to removing quenching centers from the powder surface and pores we observed an improvement in the optical properties, *i.e.* increase in tenebrescence, photoluminescence and persistent luminescence (Figs. S7).

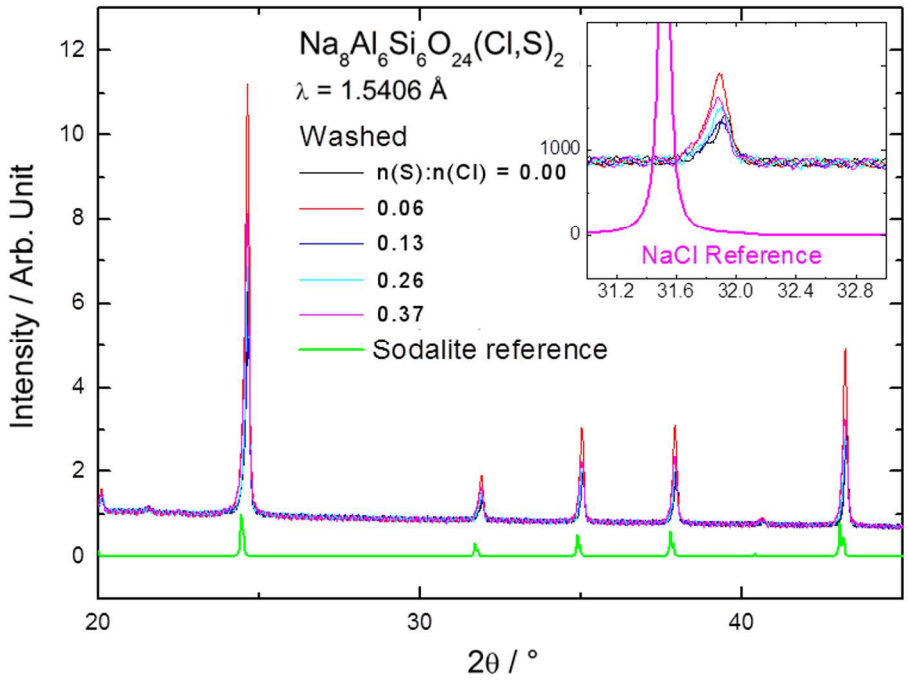

Figure S6. X-ray powder diffraction patterns of washed samples.

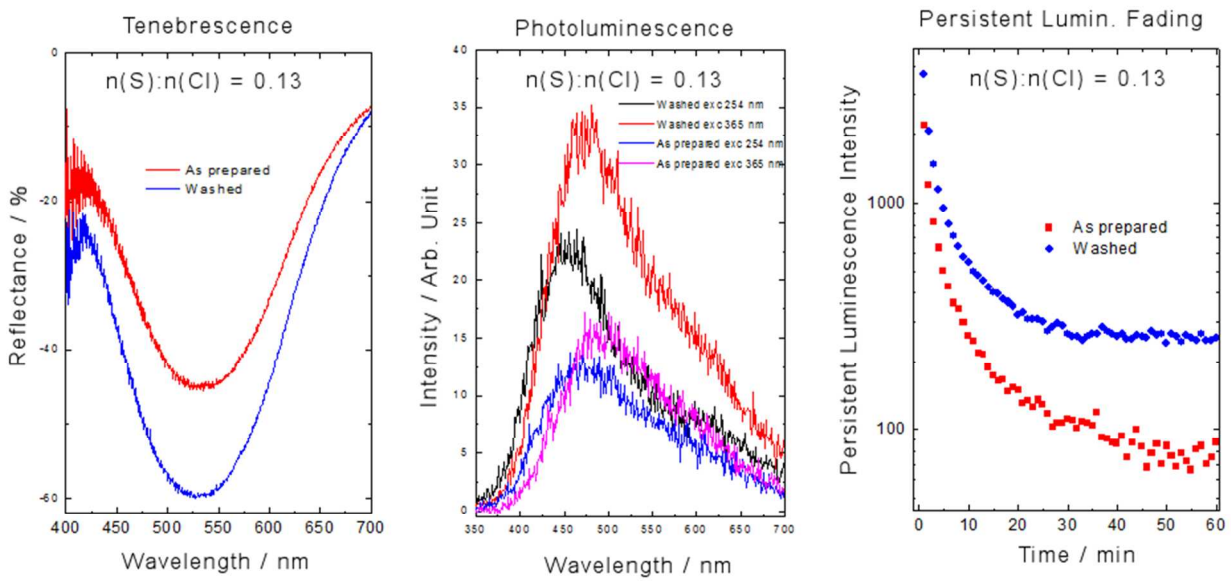

Figure S7. Results for the washed $Na_8Al_6Si_6O_{24}(Cl,S)_2$ material with n(S):n(Cl) = 0.13: intensity of tenebrescence (left), photoluminescence (middle) and persistent luminescence fading (right).