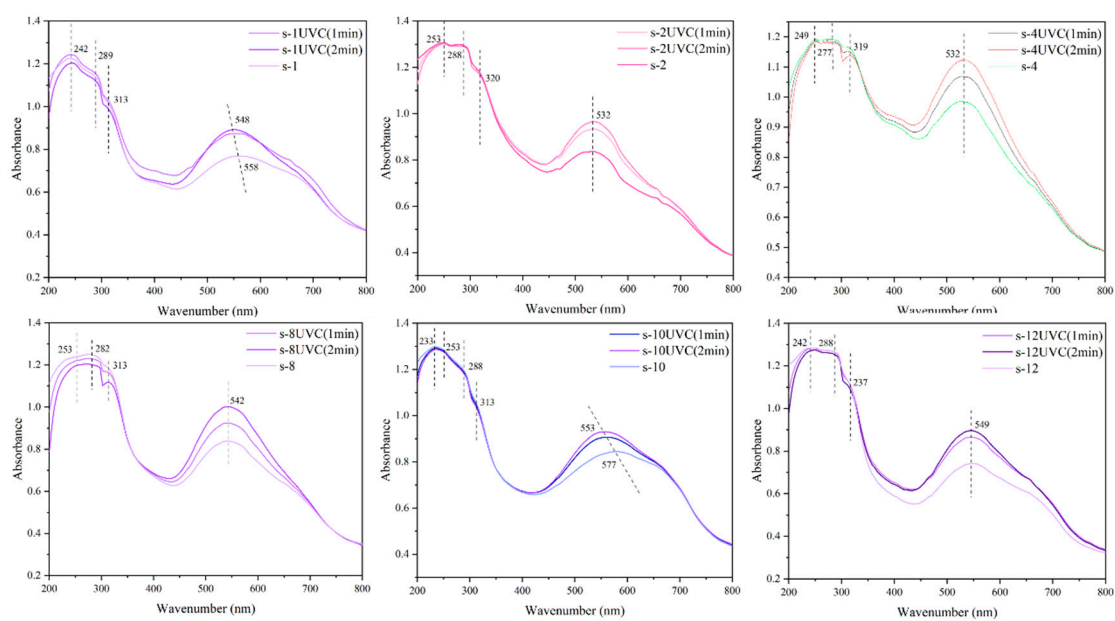


**Figure. S1 Irradiation of hackmanite samples under 365 nm UV fluorescent lamp**



**Figure. S2 UV-Vis absorption spectra of hackmanite samples before and after exposure to 254 nm ultraviolet light.**

**Table. S1 Basic gemological property parameters of hackmanite samples.**

sample	s-1	s-2	s-3	s-4	s-5
color	Light purple	Pink purple	blue	Dark purple	white
Transparent	translucency - opaque	translucency - opaque	translucency - opaque	translucency - opaque	translucency - opaque
Refractive index	1.482	1.485	1.484	1.483	1.483
Relative density	2.26	2.32	2.35	2.30	2.36
UV fluorescent	long wave: strong, purple	long wave: strong, purple	long wave: strong, blue  Short wave: no	long wave: strong orange-red Short wave: no	long wave: strong orange-red Short wave: no

**Table. S2 X-ray Fluorescence spectra analysis data of hackmanite samples (wt %).**

<b>Elements</b>	<b>s-1</b>	<b>s-8</b>	<b>s-10</b>
<b>Na<sub>2</sub>O</b>	38.131	45.190	21.753
<b>SiO<sub>2</sub></b>	25.491	24.992	37.487
<b>Al<sub>2</sub>O<sub>3</sub></b>	23.316	23.185	31.088
<b>Cl</b>	6.360	5.554	8.085
<b>CaO</b>	5.839	0.339	0.647
<b>K<sub>2</sub>O</b>	0.503	0.287	0.359
<b>SO<sub>3</sub></b>	0.255	0.301	0.356
<b>Fe<sub>2</sub>O<sub>3</sub></b>	0.040	0.016	0
<b>Ta<sub>2</sub>O<sub>5</sub></b>	0.032	0	0
<b>Br</b>	0.021	0.012	0.020
<b>SrO</b>	0.005	0	0
<b>CuO</b>	0.004	0.003	0.014
<b>Rb<sub>2</sub>O</b>	0.001	0.001	0.002
<b>Ir<sub>2</sub>O<sub>3</sub></b>	0	0.052	0.011
<b>BaO</b>	0	0.036	0
<b>HfO<sub>2</sub></b>	0	0.014	0
<b>OsO<sub>4</sub></b>	0	0.009	0.046
<b>PtO<sub>2</sub></b>	0	0.009	0
<b>As<sub>2</sub>O<sub>3</sub></b>	0	0	0.042
<b>Cr<sub>2</sub>O<sub>3</sub></b>	0	0	0.038
<b>Sc<sub>2</sub>O<sub>3</sub></b>	0	0	0.021
<b>TiO<sub>2</sub></b>	0	0	0.020
<b>HgO</b>	0	0	0.010
<b>Total</b>	99.998	100	99.999

Table S3 LA-ICP-MS data of hackmanite

		s-1-1	s-1-2	s-1-3	s-4-1	s-4-2	s-4-3	s-8-1	s-8-2	s-8-3	s-10-1	s-10-2	s-10-3
Li	ppm	139.01	154.29	160.06	93.31	106.39	113.45	124.57	125.80	89.61	94.48	104.02	102.94
Be	ppm	80.74	75.93	72.87	61.79	81.07	86.47	72.67	78.88	106.49	72.93	72.88	69.28
B	ppm	190.17	171.24	187.87	172.11	167.06	194.87	199.77	183.28	166.08	178.57	185.71	178.74
Na <sub>2</sub> O	wt%	25.54	24.78	24.41	24.68	24.45	24.88	25.33	24.65	23.38	24.28	24.65	24.66
MgO	wt%	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Al <sub>2</sub> O <sub>3</sub>	wt%	32.26	31.48	31.72	31.60	31.64	31.39	32.35	31.47	33.33	31.10	31.30	31.31
SiO <sub>2</sub>	wt%	36.12	37.46	37.56	37.75	37.93	37.74	36.11	37.73	37.18	38.53	37.90	37.88
P <sub>2</sub> O <sub>5</sub>	wt%	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02
K <sub>2</sub> O	wt%	0.17	0.39	0.37	0.14	0.11	0.11	0.28	0.27	0.25	0.21	0.22	0.22
CaO	wt%	0.08	0.09	0.10	0.03	0.04	0.03	0.13	0.07	0.05	0.07	0.13	0.12
Sc	ppm	1.97	0.61	0.32	0.47	0.27	0.78	0.50	1.57	0.08	0.57	1.76	0.86
TiO <sub>2</sub>	wt%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V	ppm	0.01	1.48	0.00	9.33	4.16	0.00	0.00	3.61	5.96	4.10	0.00	3.42
Cr	ppm	6.01	0.00	0.00	20.45	21.69	0.00	0.00	12.85	15.79	17.11	2.67	14.52
MnO	wt%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	wt%	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
Co	ppm	0.23	0.00	0.00	0.27	0.87	0.00	0.00	0.39	0.00	0.57	0.69	0.58
Ni	ppm	6.25	0.62	0.00	6.73	0.00	0.00	0.00	1.18	0.00	0.00	0.00	11.00
Cu	ppm	0.00	0.14	0.75	0.16	0.00	0.00	0.11	0.17	0.00	0.85	0.00	0.00
Zn	ppm	0.76	0.83	0.00	18.27	44.20	14.30	0.59	1.13	3.40	0.11	0.00	0.00
Ga	ppm	21.58	20.94	19.99	23.54	25.74	23.69	21.42	19.39	19.99	18.73	19.44	21.13
Ge	ppm	0.00	3.65	2.58	0.00	2.72	0.29	2.42	2.24	2.08	0.19	1.84	0.00
Se	ppm	178.56	0.00	121.31	0.00	76.93	209.73	0.00	50.24	0.00	165.73	0.00	37.71
Rb	ppm	0.85	3.07	2.56	0.48	0.11	0.33	2.65	1.77	1.13	0.72	1.56	1.99
Sr	ppm	0.01	0.18	0.08	1.39	0.33	0.07	0.25	0.14	0.04	0.10	0.00	0.10
Y	ppm	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.03	0.00	0.00	0.01
Zr	ppm	0.00	0.09	0.15	0.00	0.00	0.00	0.86	0.02	0.03	0.00	0.00	0.00
Nb	ppm	0.00	0.00	0.00	0.95	0.54	0.20	0.02	0.01	0.03	0.02	0.00	0.00
Mo	ppm	0.00	0.04	0.02	0.07	0.35	0.00	0.03	0.09	0.10	0.05	0.13	0.13
Ag	ppm	0.18	0.04	0.00	0.31	0.00	0.10	0.17	0.08	0.12	0.00	0.00	0.00
Sn	ppm	0.25	0.43	0.35	0.14	0.24	0.17	0.17	0.39	0.20	0.15	0.46	0.32
Sb	ppm	0.03	0.00	0.00	0.13	0.00	0.04	0.00	0.13	0.00	0.02	0.03	0.05
Cs	ppm	0.45	2.46	1.70	0.29	0.10	0.41	2.41	1.40	1.31	0.35	3.47	2.17
Ba	ppm	1.26	0.11	0.00	7.37	0.45	1.09	0.13	0.07	1.57	0.01	1.24	1.07
La	ppm	0.00	0.00	0.01	0.00	0.00	0.03	0.00	0.00	0.01	0.01	0.00	0.00
Ce	ppm	0.01	0.00	0.01	0.00	0.00	0.03	0.01	0.01	0.00	0.00	0.00	0.00
Pr	ppm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Nd	ppm	0.00	0.06	0.03	0.00	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.02
Sm	ppm	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.00	0.02
Eu	ppm	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02
Gd	ppm	0.01	0.00	0.00	0.03	0.00	0.04	0.00	0.05	0.14	0.00	0.01	0.11
Tb	ppm	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00

Dy	ppm	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.02	0.00
Ho	ppm	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Er	ppm	0.00	0.01	0.03	0.00	0.04	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Tm	ppm	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00
Yb	ppm	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.00
Lu	ppm	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
Hf	ppm	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Ta	ppm	0.00	0.00	0.00	0.03	0.02	0.01	0.00	0.01	0.00	0.00	0.01	0.00
W	ppm	0.23	0.10	0.15	3.17	1.30	1.66	0.10	0.19	0.09	0.16	0.08	0.08
Tl	ppm	0.00	0.02	0.01	0.18	0.01	0.01	0.02	0.03	0.00	0.03	0.02	0.05
Bi	ppm	0.02	0.00	0.01	0.05	0.00	0.05	0.01	0.01	0.00	0.01	0.01	0.00
Pb	ppm	0.03	0.02	0.02	2.41	0.48	1.04	0.00	0.03	0.08	0.04	0.05	0.00
Th	ppm	0.01	0.00	0.00	0.14	0.06	0.15	0.00	0.01	0.02	0.00	0.01	0.01
U	ppm	0.04	0.01	0.00	0.03	0.01	0.24	0.02	0.01	0.03	0.01	0.00	0.01