SAND2011-2098C

U.S. DEPARTMENT OF ENERGY | Nuclear Energy

The Fuel Cycle Research & Development

Fundamental Waste Forms: Fission Product Decay

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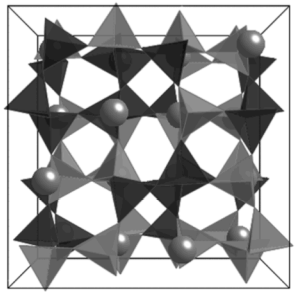
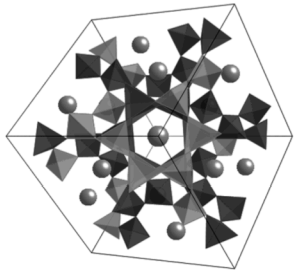
Pollucite: $CsAlSi_2O_6$, "condensed" Zeolite-like Oxide Waste Form Phase

Program Objectives:
Establish durability of ceramic waste forms for disposing of
Cs, Sr and decay products
Determine structure of ceramic waste form candidates using
Correlation with PNNL modeling and ion implantation efforts
Develop structure-property relations to provide predictive capabilities
regarding key performance parameters.

$CsAlSi_2O_6$





Pollucite structure down
[100] and [111]

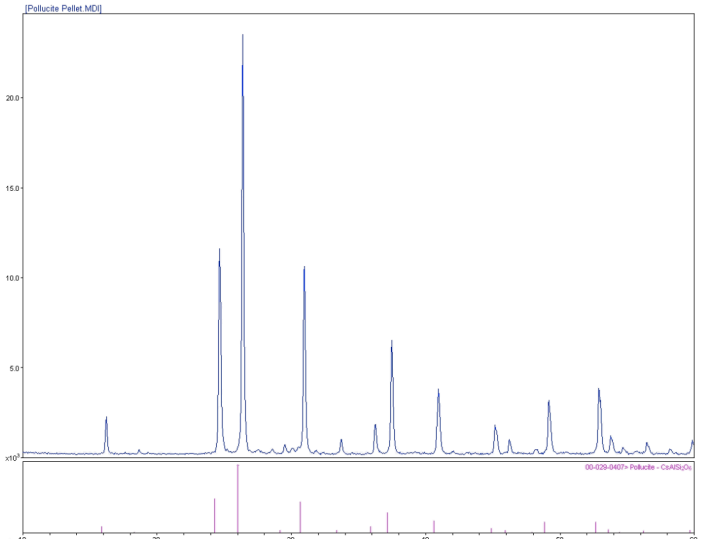
1 pure sample delivered to PNNL, 3/15/11;
2-3 more samples being prepared

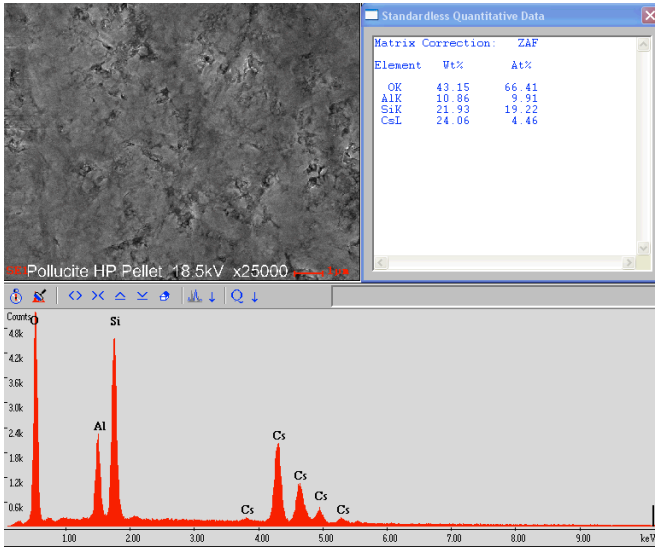
SNL synthesized pollucite for
characterization and
ion implantation (PNNL):

$CsAlSi_2O_6$ prep (from JACerS, 1999, 82(11), 3242)

$CsOH/H_2O$ mixed in a Teflon reactor.
Al (fine powder) is slowly dissolved in mixture
H_2O, TEOS, Ethanol are added.
Solution is stirred until a colloidal gel forms.
Reactor heated at 220°C for 2 hours.
Product is heat treated at 1100°C for 1 hour.

Phase Pure
$CsAlSi_2O_6$ pellet





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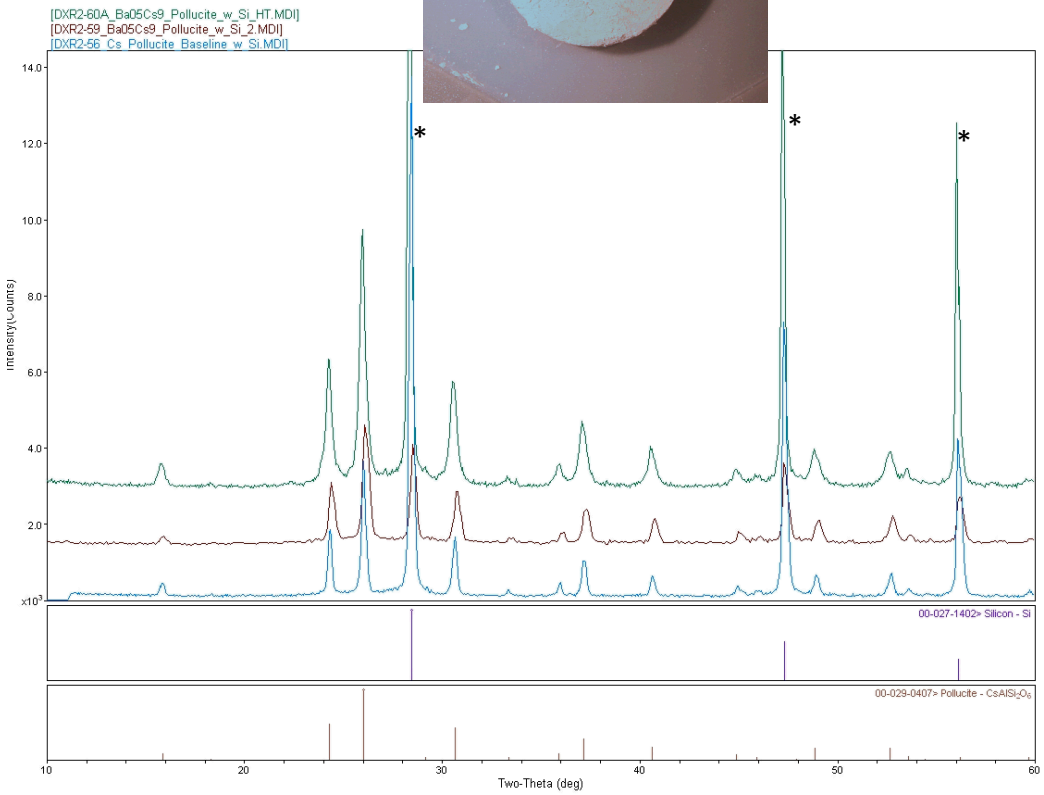
Pollucite: Cs,Ba-$AlSi_2O_6$, "condensed" Zeolite-like Oxide Waste Form Phase

SNL synthesized: $Cs_{0.9}Ba_{0.05}AlSi_2O_6$

$CsOH/(Ba(OH)_2\text{-}8H_2O/CsOH)$
H_2O mixed in a Teflon reactor.
Al (fine powder) is slowly dissolved in mixture
H_2O, TEOS, Ethanol are added.
Solution is stirred until a colloidal gel forms.
Reactor heated at 220°C for 2 hours.
Product is heat treated at 1100°C for 1 hour.

5/8 inch
Pre sintered
Pellet

XRD data (w/Silicon Standard, see *)
- Ba is smaller radius than Cs
- Monitoring XRD shifts, if due to level of pellet in beam or change in unit cell
- Comparison of blue (CsAlSiO) and red (Cs,Ba-AlSiO) shows contraction of unit cell w/Ba incorporation



Still To Do:
1) Sinter
2) SEM/EDS
3) XRD structure refinement (confirm location of Ba)
4) Deliver sample(s) to PNNL; completion of milestone M41SW070303 by 4/15/11
5) Explore maximum loading of Ba with phase purity

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