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The behaviour of AlMg3 after irradiation at high proton and neutron fluences

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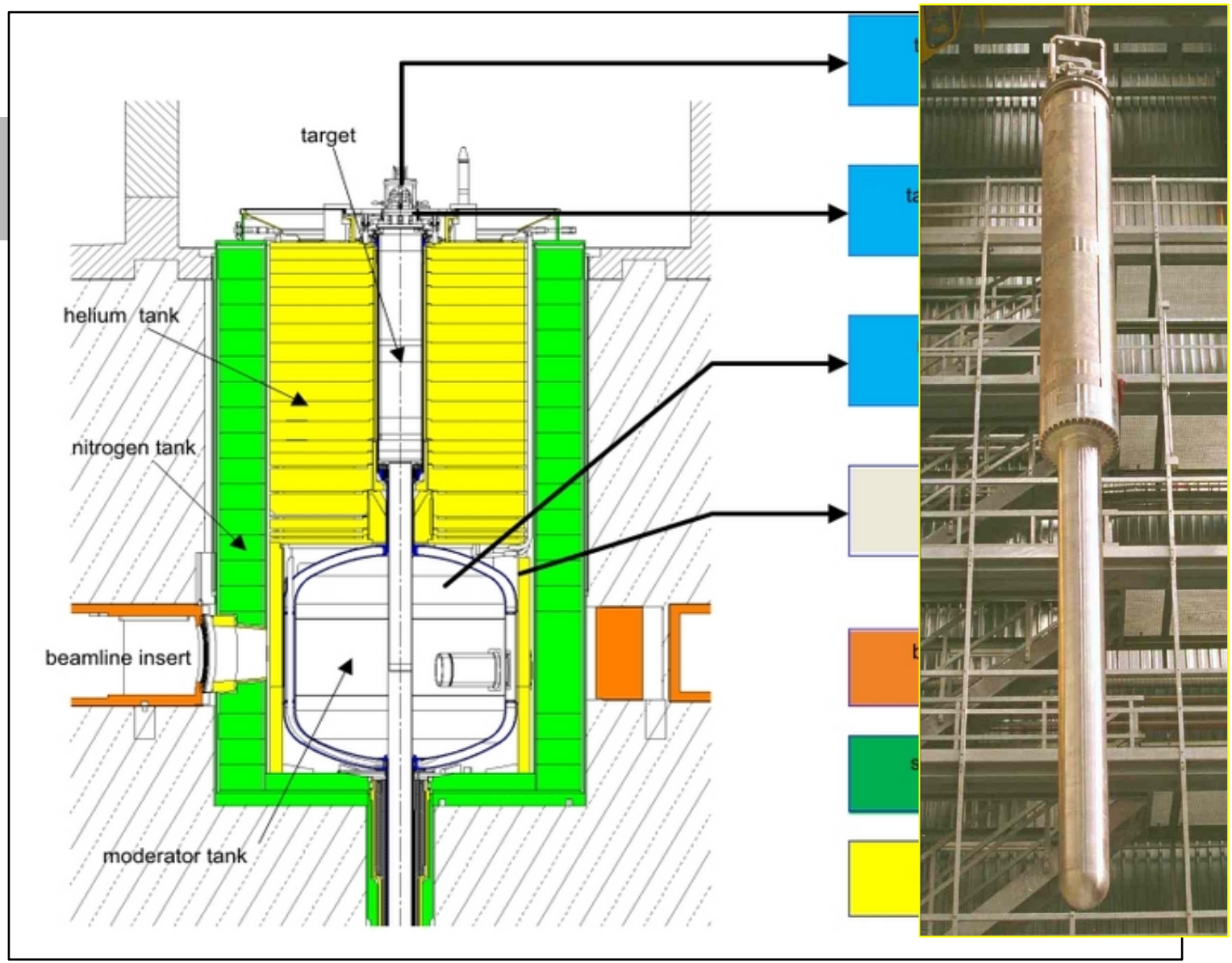
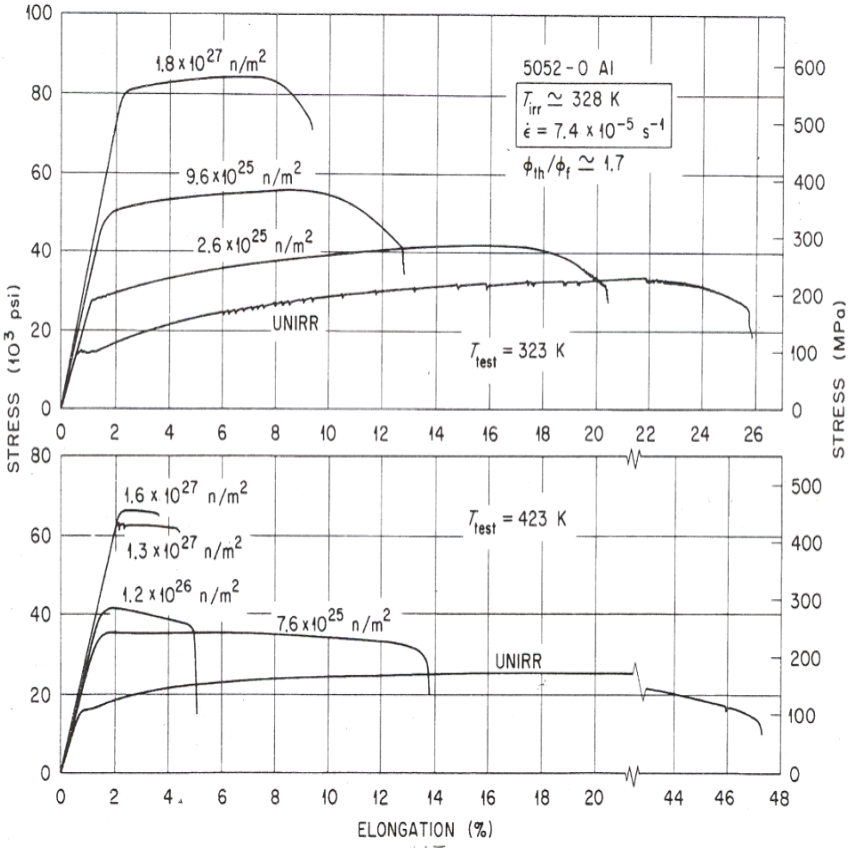
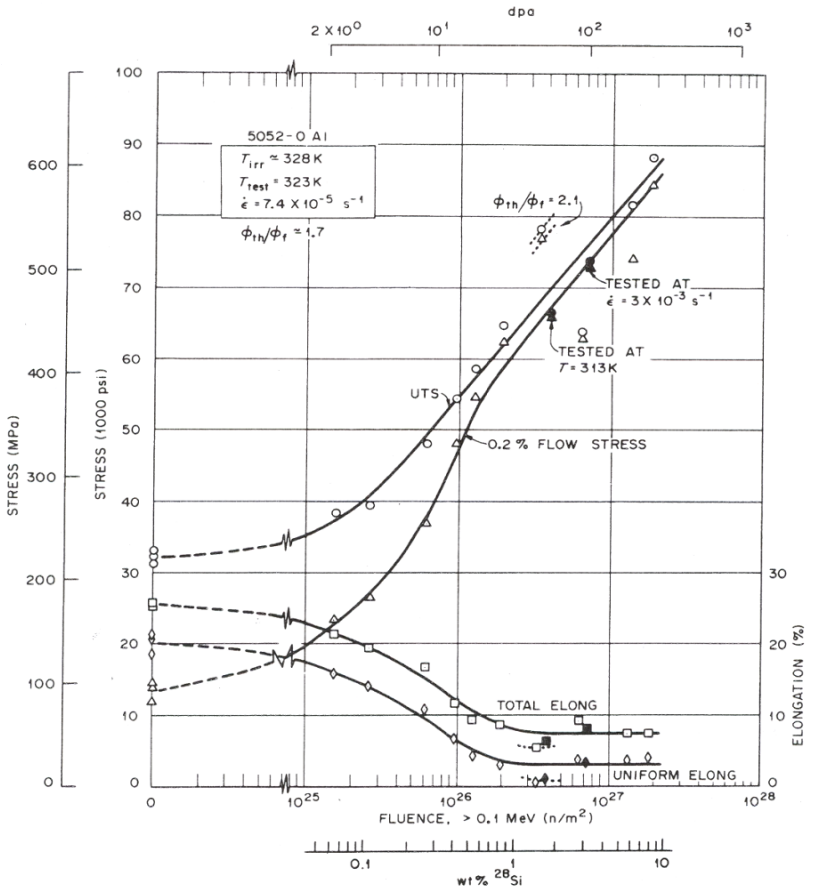
Introduction



Introduction





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Introduction

Aluminium and Al-alloy are known having good thermal conductivity, low neutron absorption, and super radiation damage resistance.

Al-alloy 5052 (has a lot of data of neutron irradiation (up to 2×10^{27} n/m^2, which shows Al5052 has very good resistance to cavity formation and swelling compared to the other Al alloys

The composition of Al5052 is close to AlMg3.

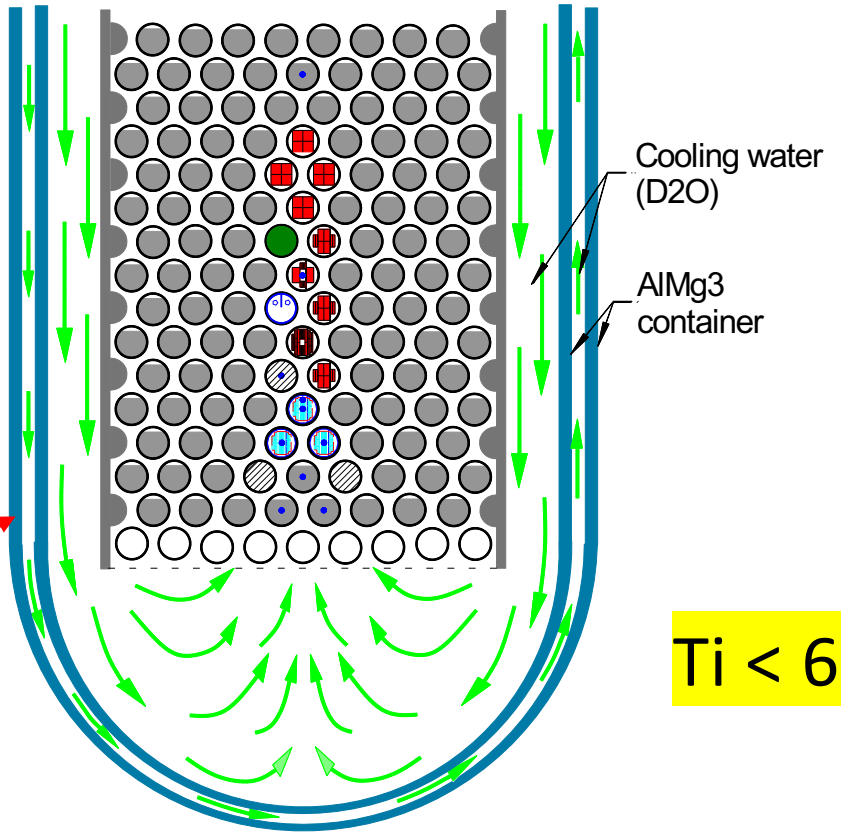
Composition of AlMg3

Al	Si	Fe	Cu	Mn	Mg	Cr	Ti	Zn
bal.	0.30	0.25	0.03	0.35	2.72	0.04	0.01	0.04

SINQ Target Safety Hull

Convex Type

Applied to Targets 1 – 7, 10



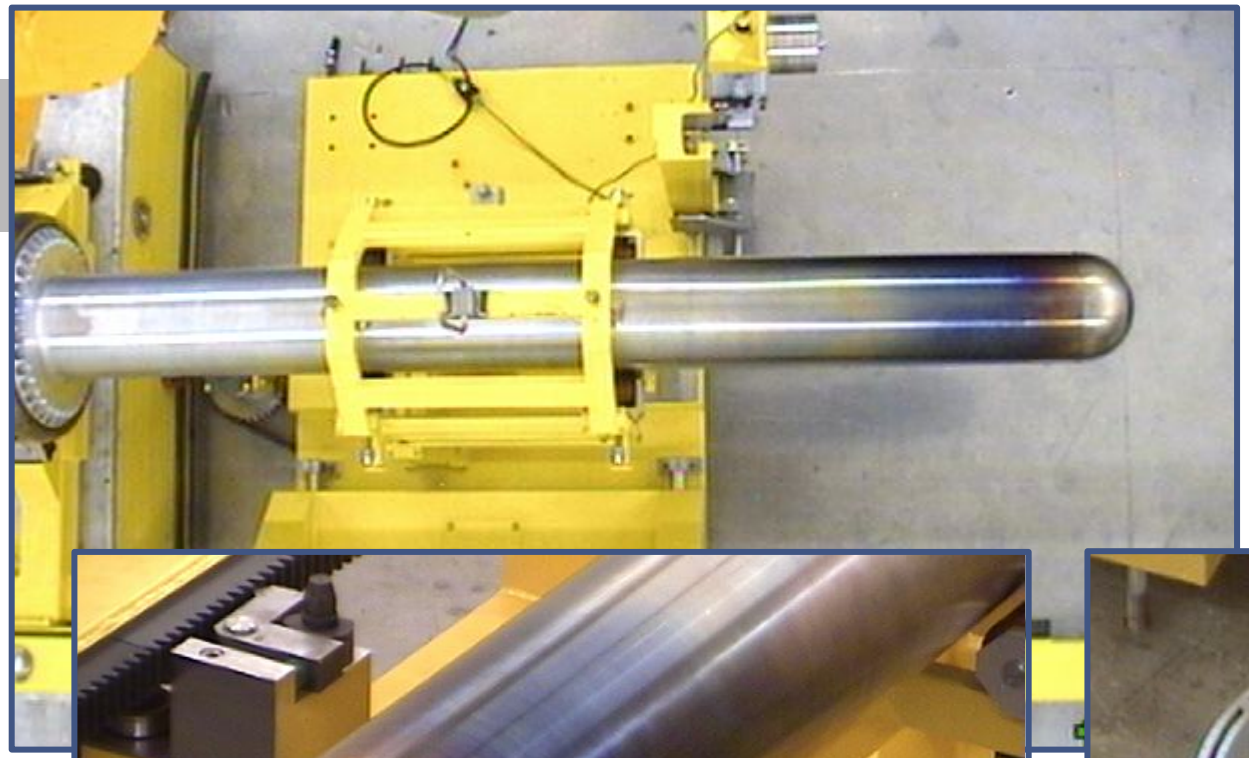
Ti < 60°C

SINQ Target Safety Hull

Convex Type

Target 4

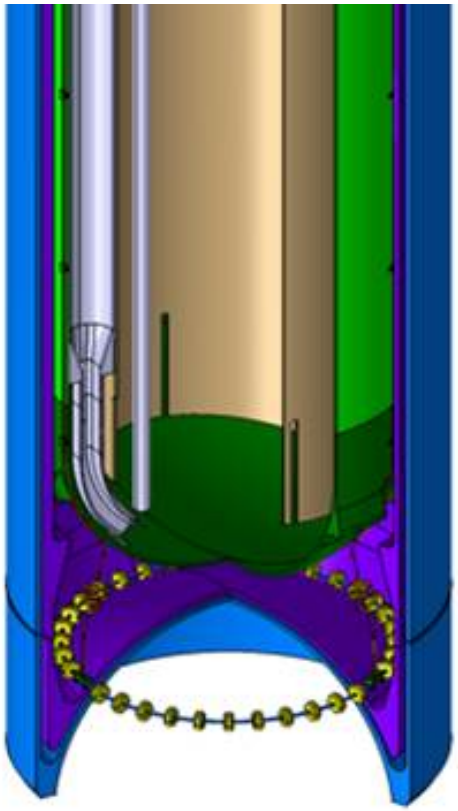
10.03 Ah p+

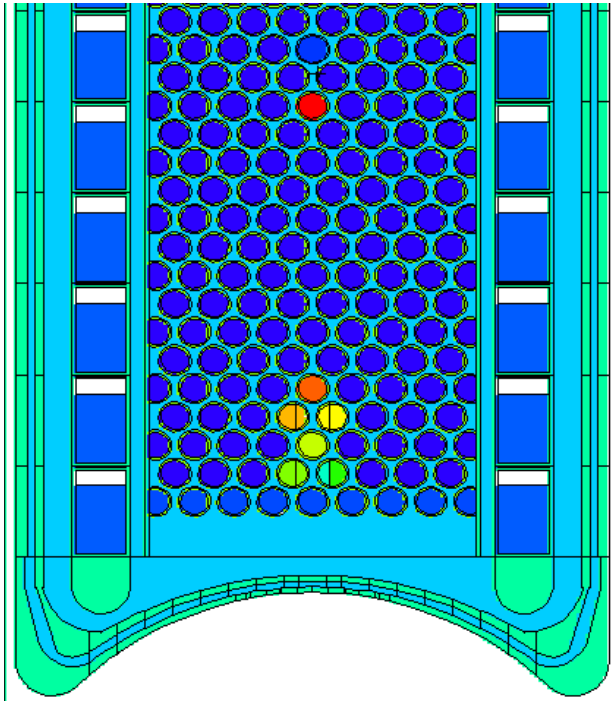


SINQ Target Safety Hull

Concave Type

Applied to Targets: Megapie, 8 ,9, 11, 12…



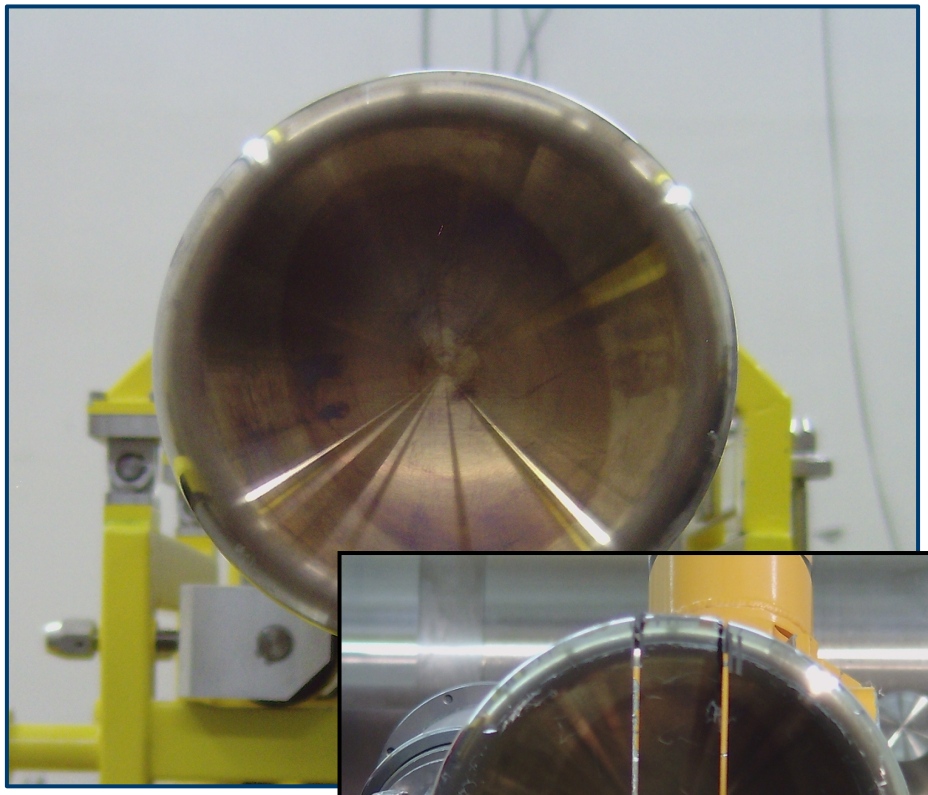


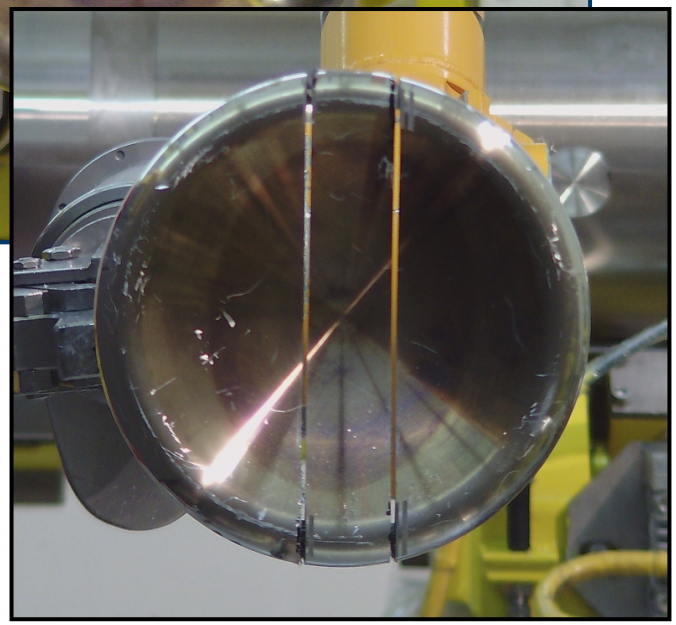
SINQ Target Safety Hull

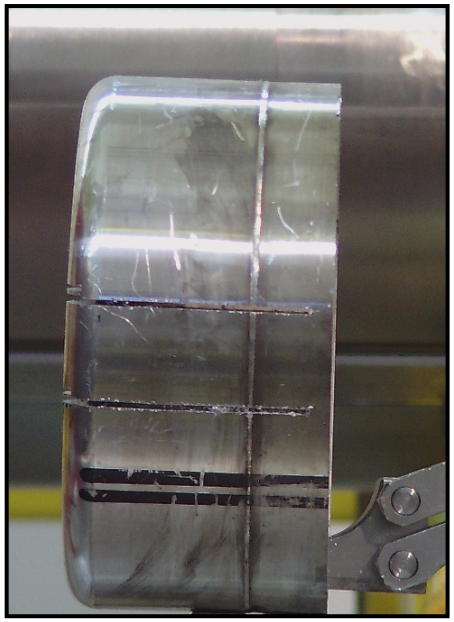
Concave Type

Target 9

13.15 Ah p+



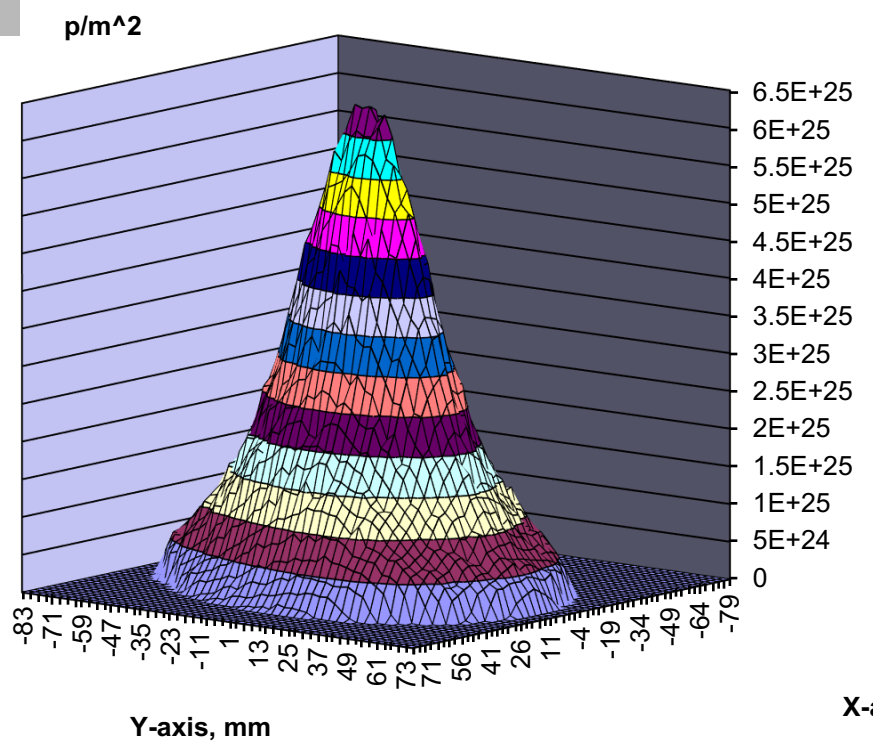


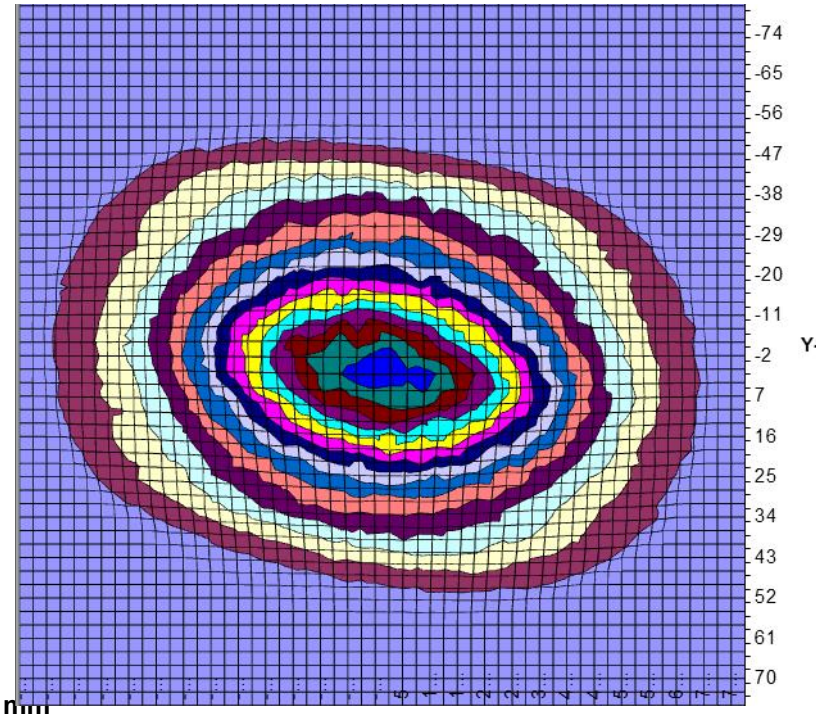


SINQ Target Safety Hull

Gamma mapping

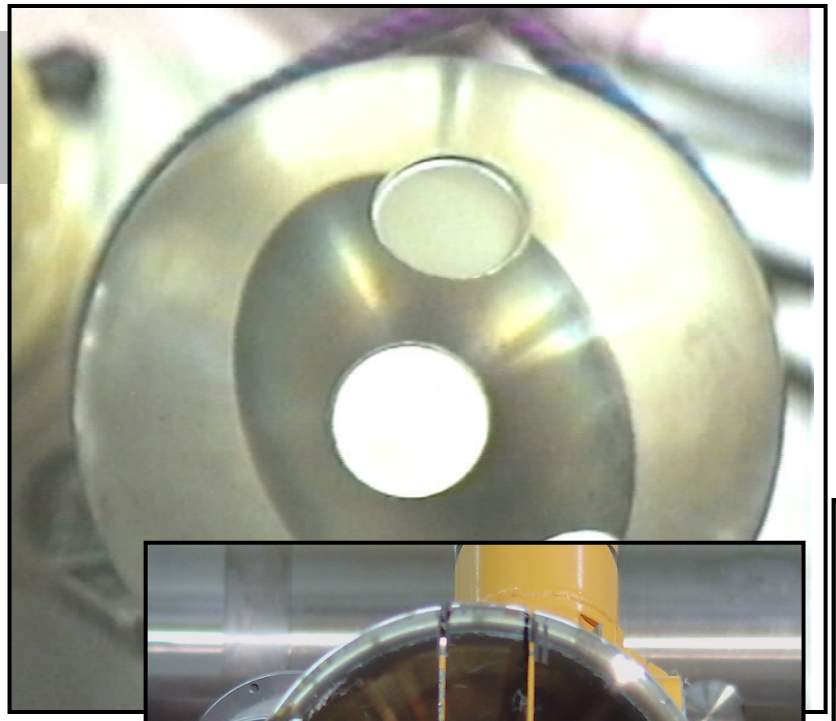
Proton fluence distribution of STIP-II, Target-4





SINQ Target Safety Hull

Sample extraction



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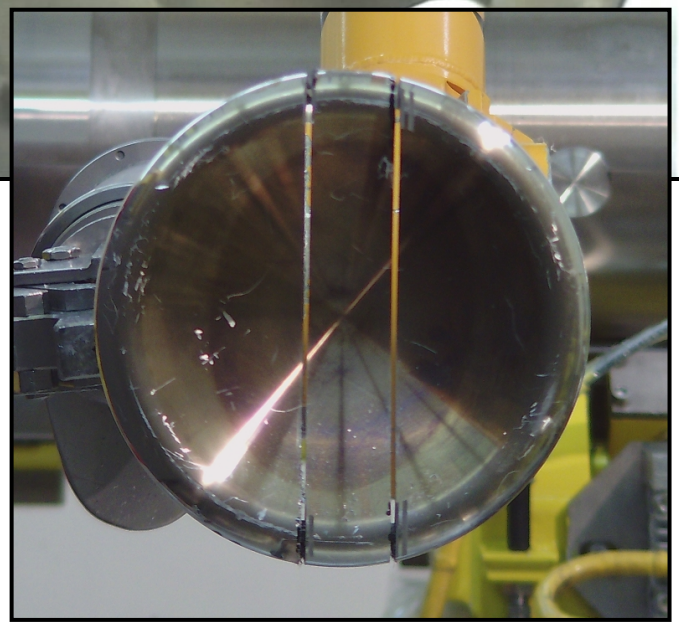
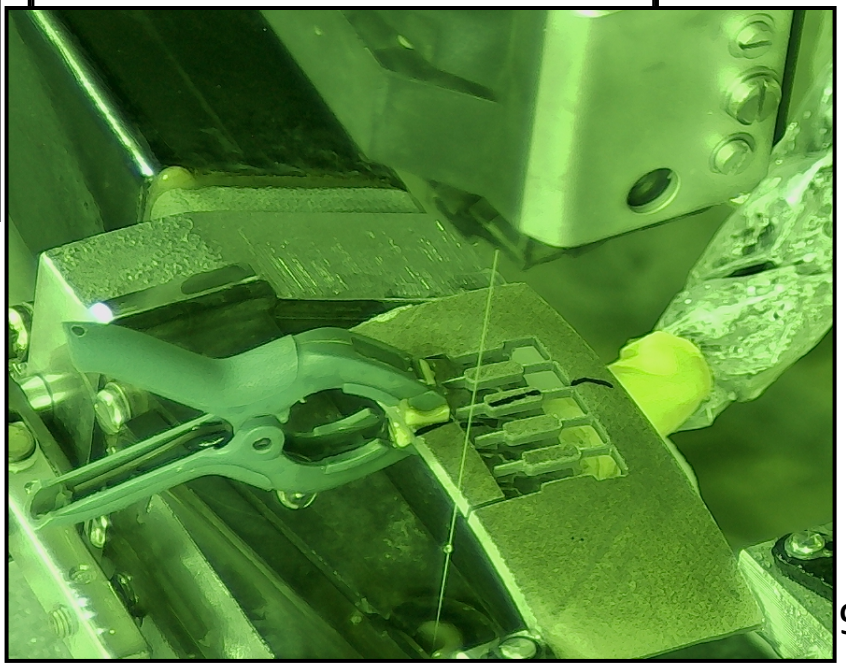
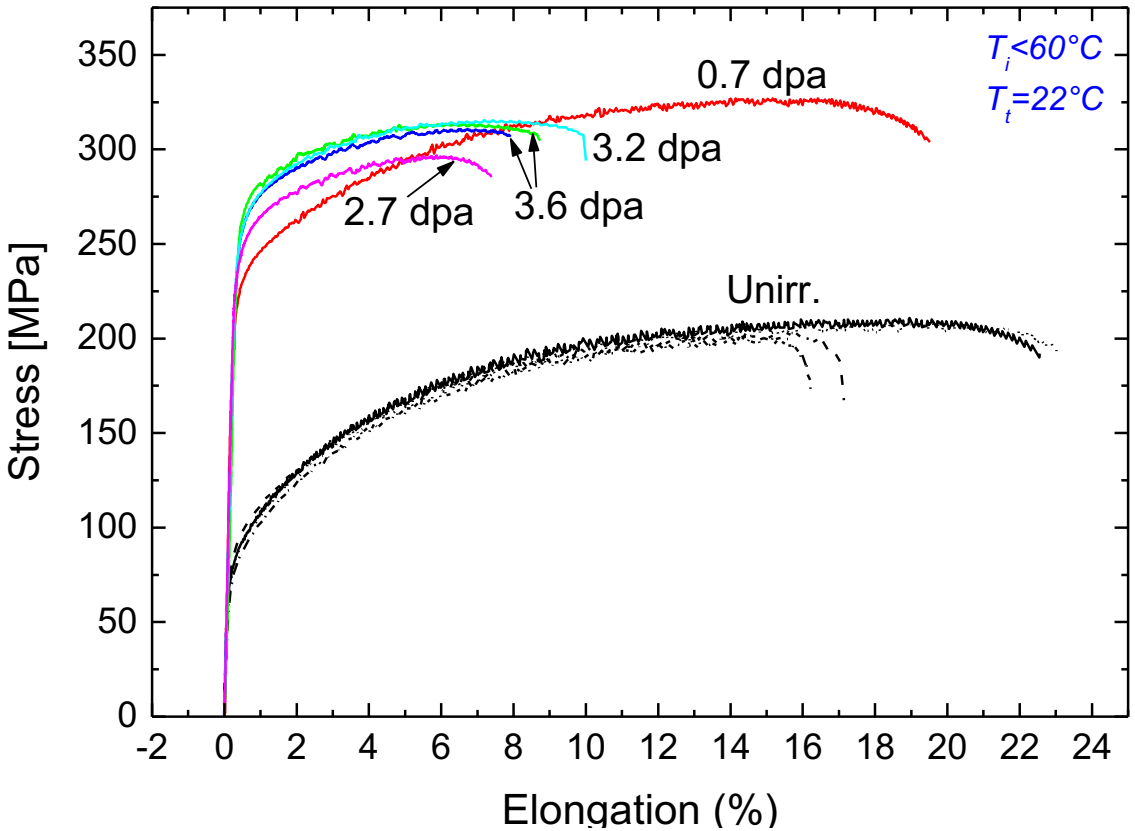


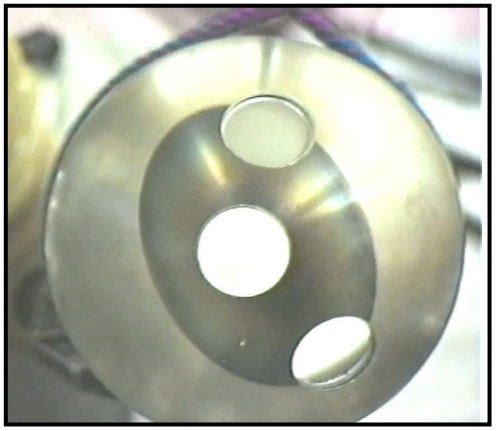


Mech properties of AlMg3 after irradaition

Target 3

6.68Ah p+





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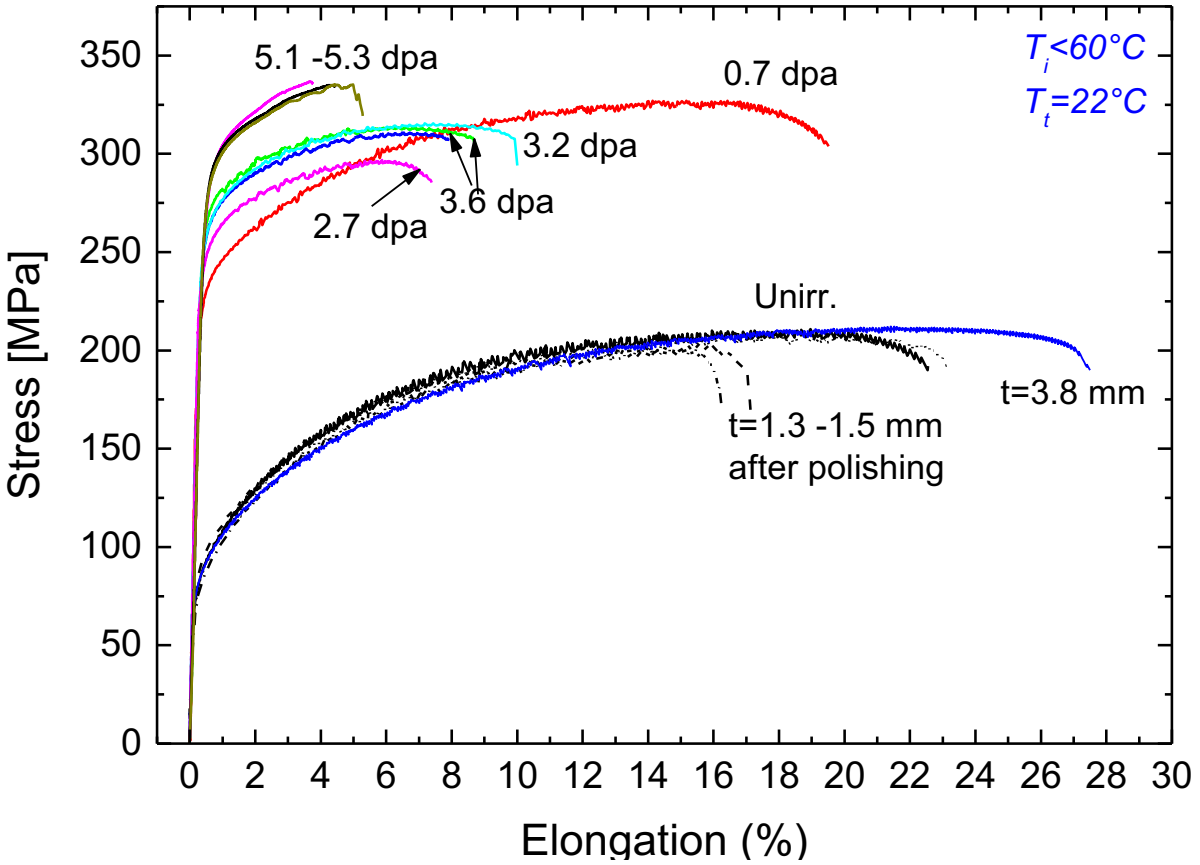
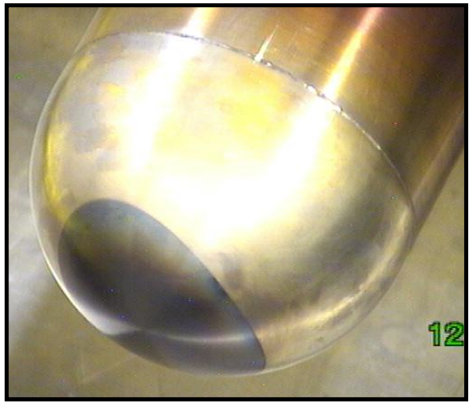
⇒ **Safety hull is SAFE after one-year irradiation!**

Mech properties of AlMg3 after irradaition

Target 4

10.03Ah p+

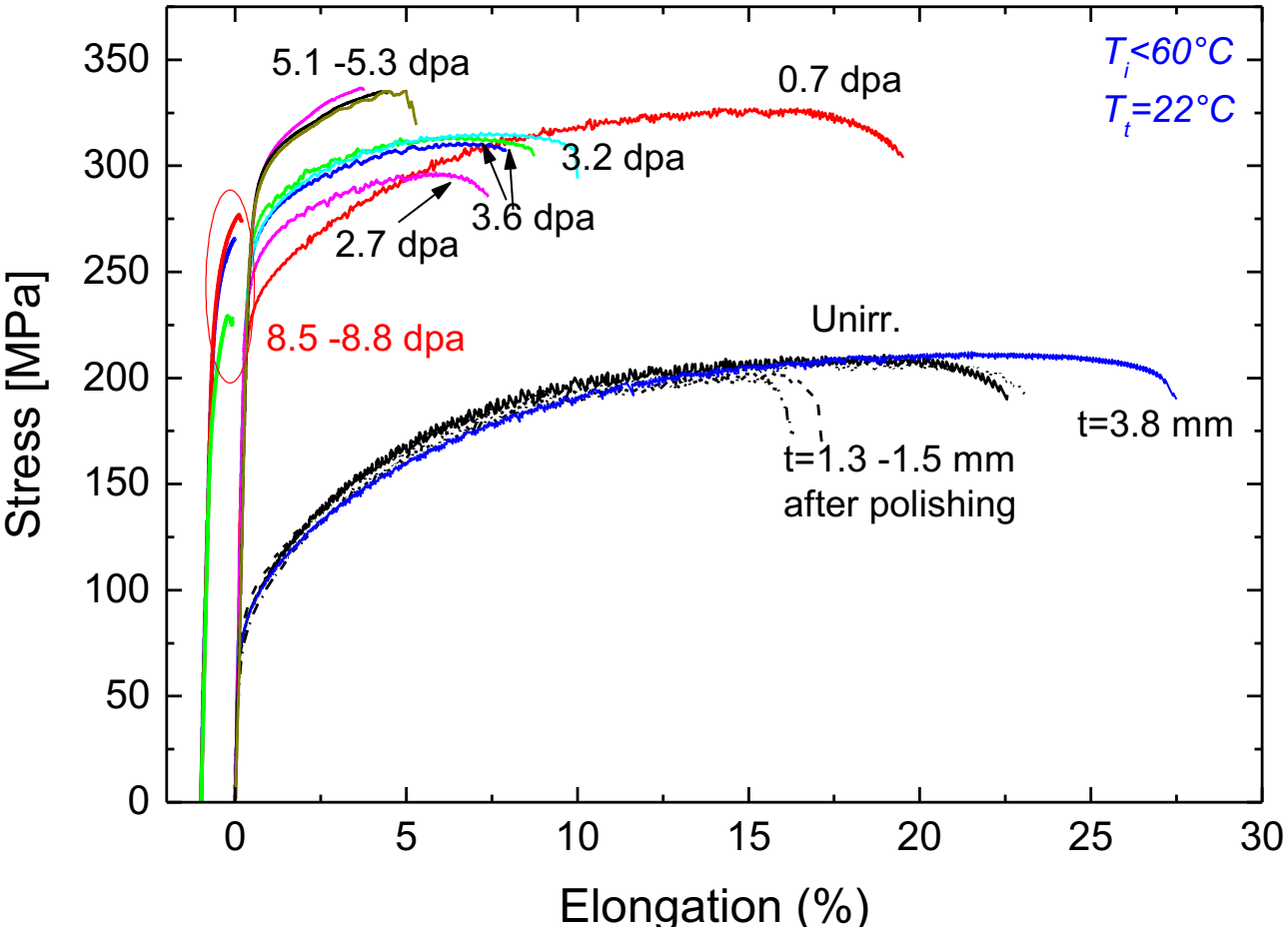


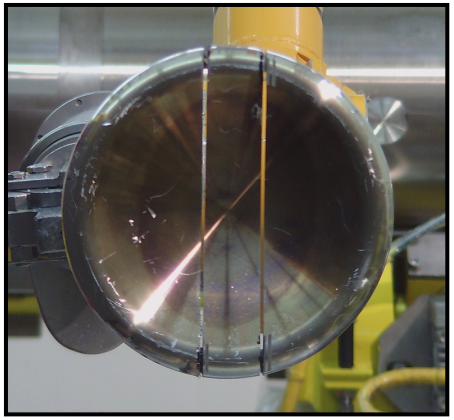


Mech properties of AlMg3 after irradaition

Target 9

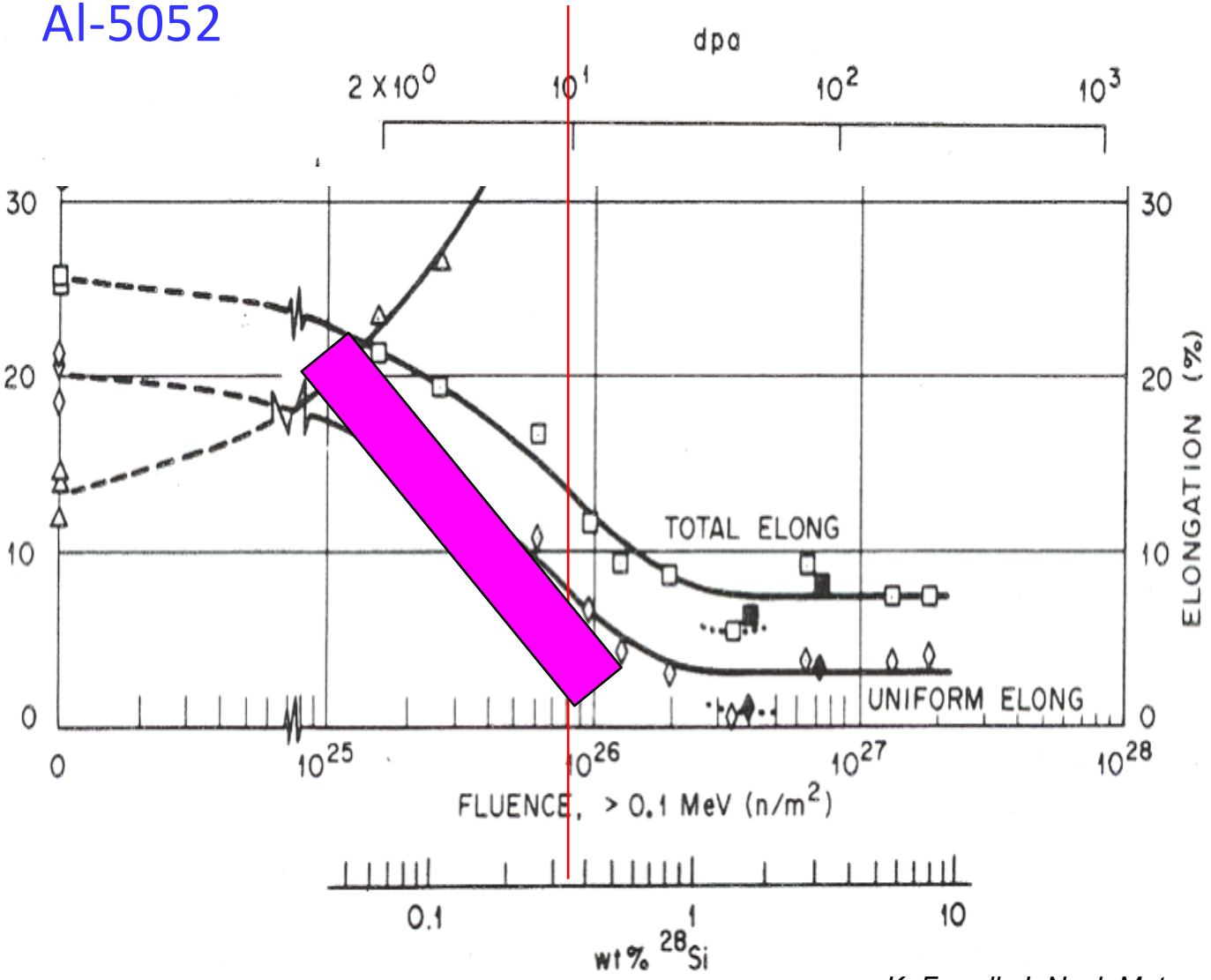
13.15 Ah p+





Mech properties of AlMg3 after irradaition

Al-5052



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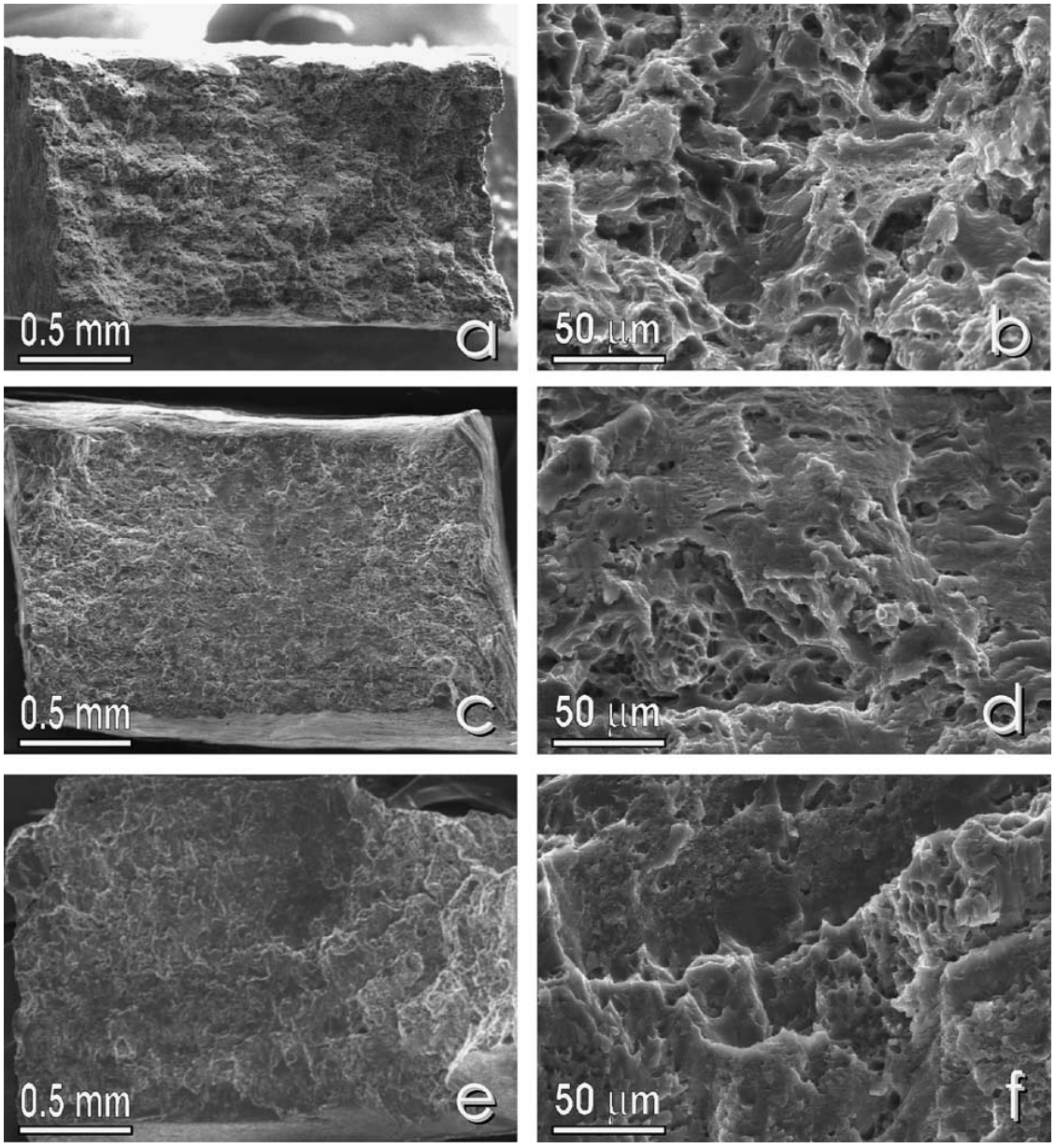
Fracture behavior of AlMg3 after irradaition



0 dpa

0.7 dpa

3.6 dpa

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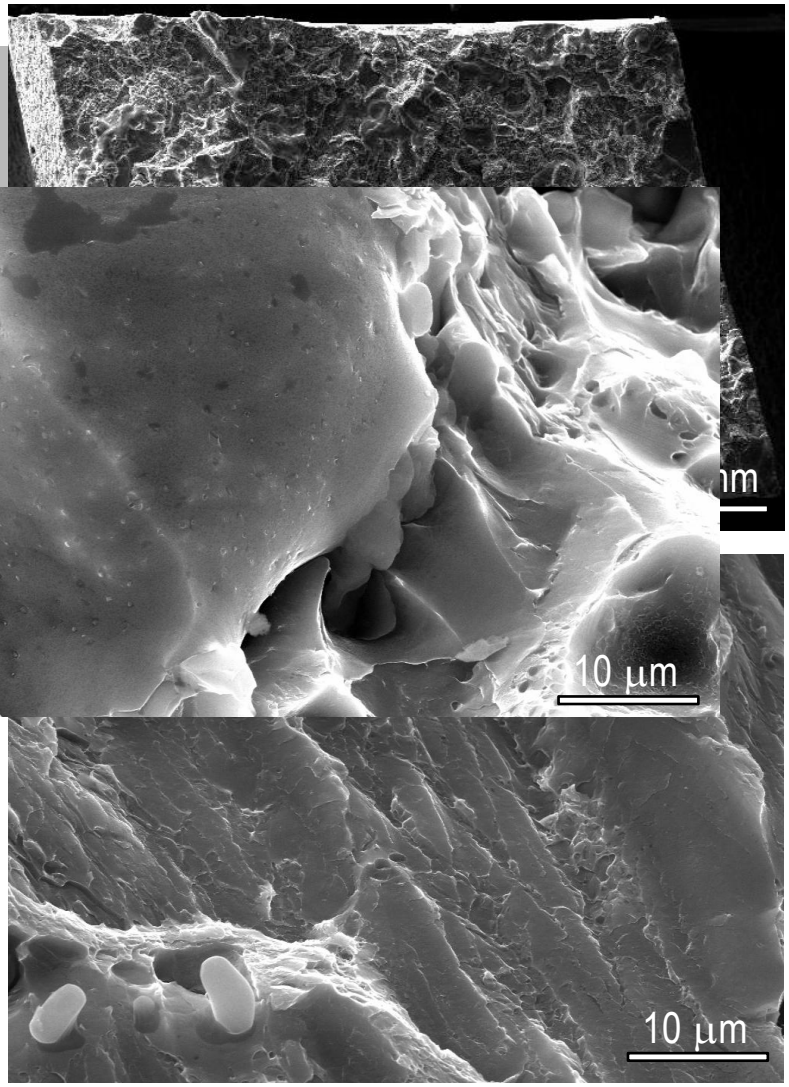
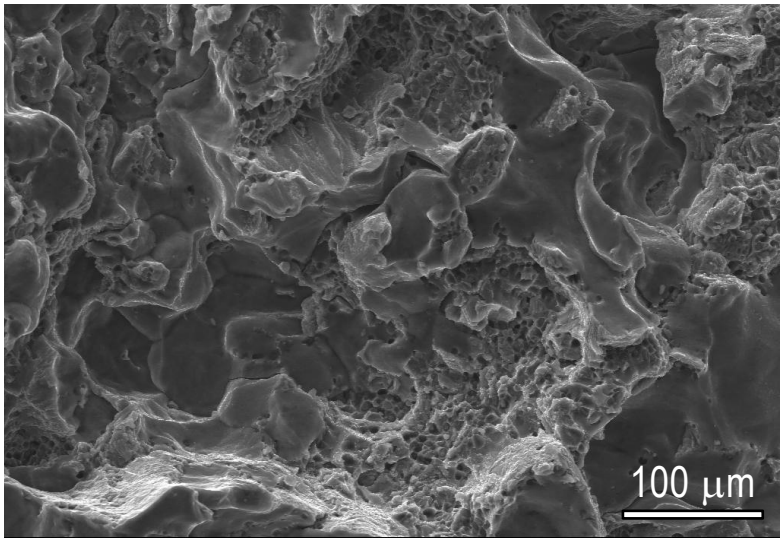
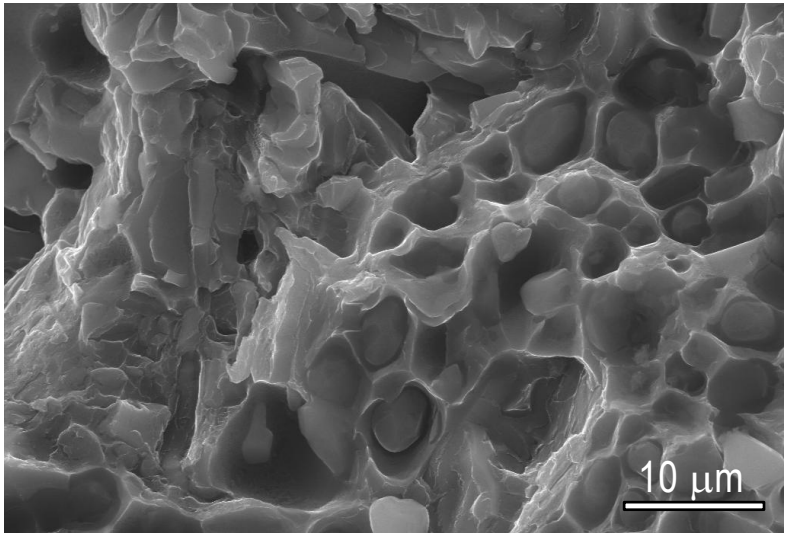
Fracture behavior of AlMg3 after irradaition

5.2 dpa

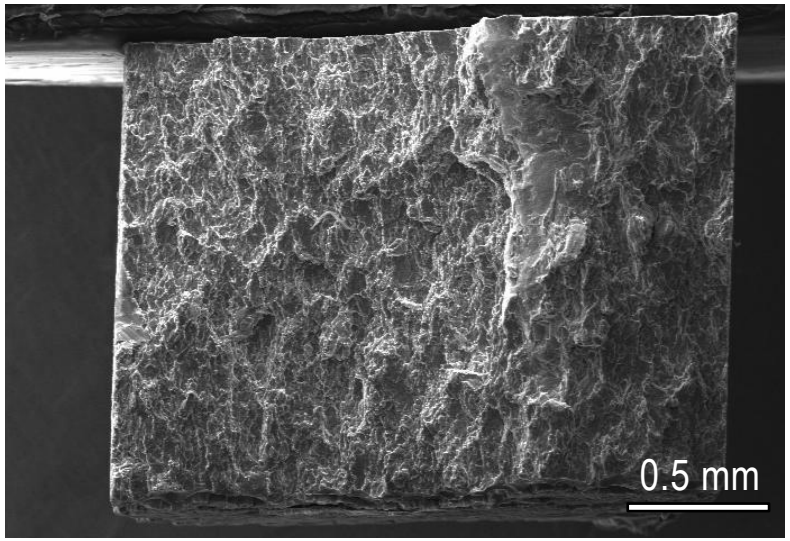


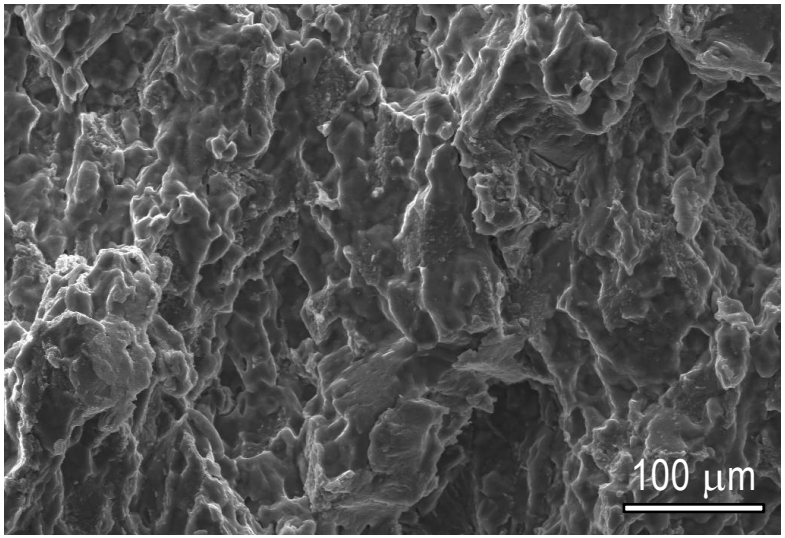


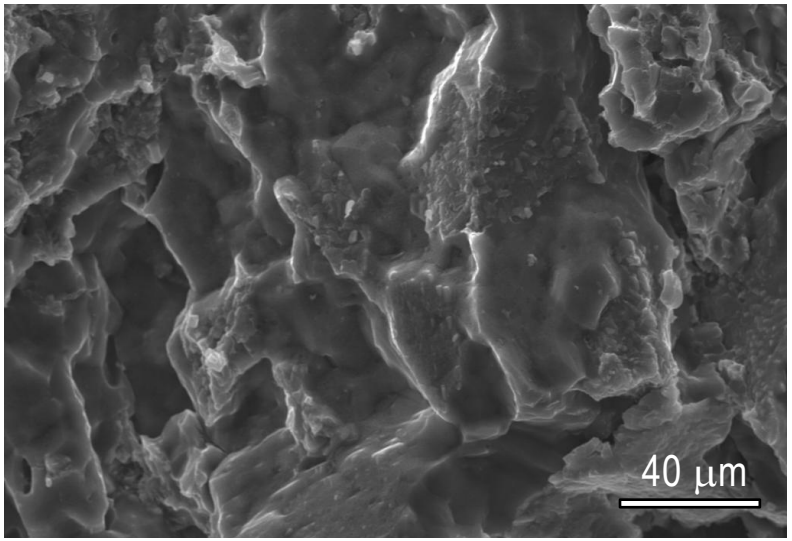


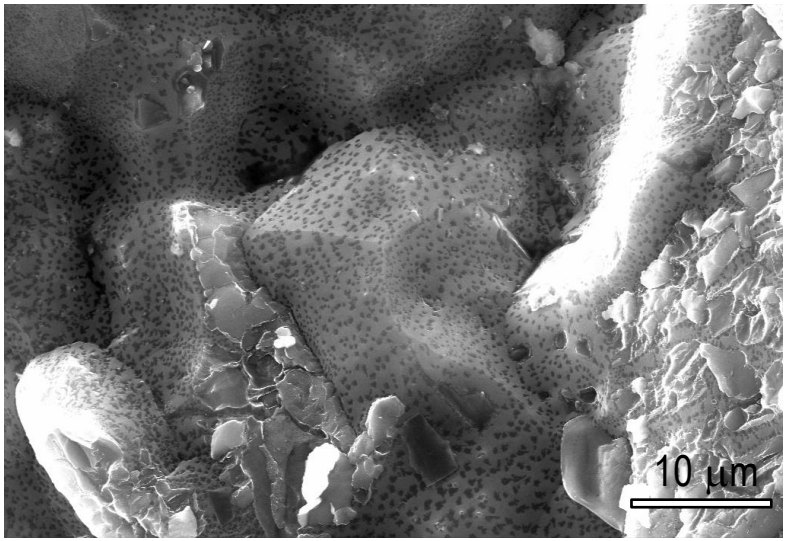
Fracture behavior of AlMg3 after irradaition

8.5 dpa









Fracture behavior of AlMg3 after irradaition

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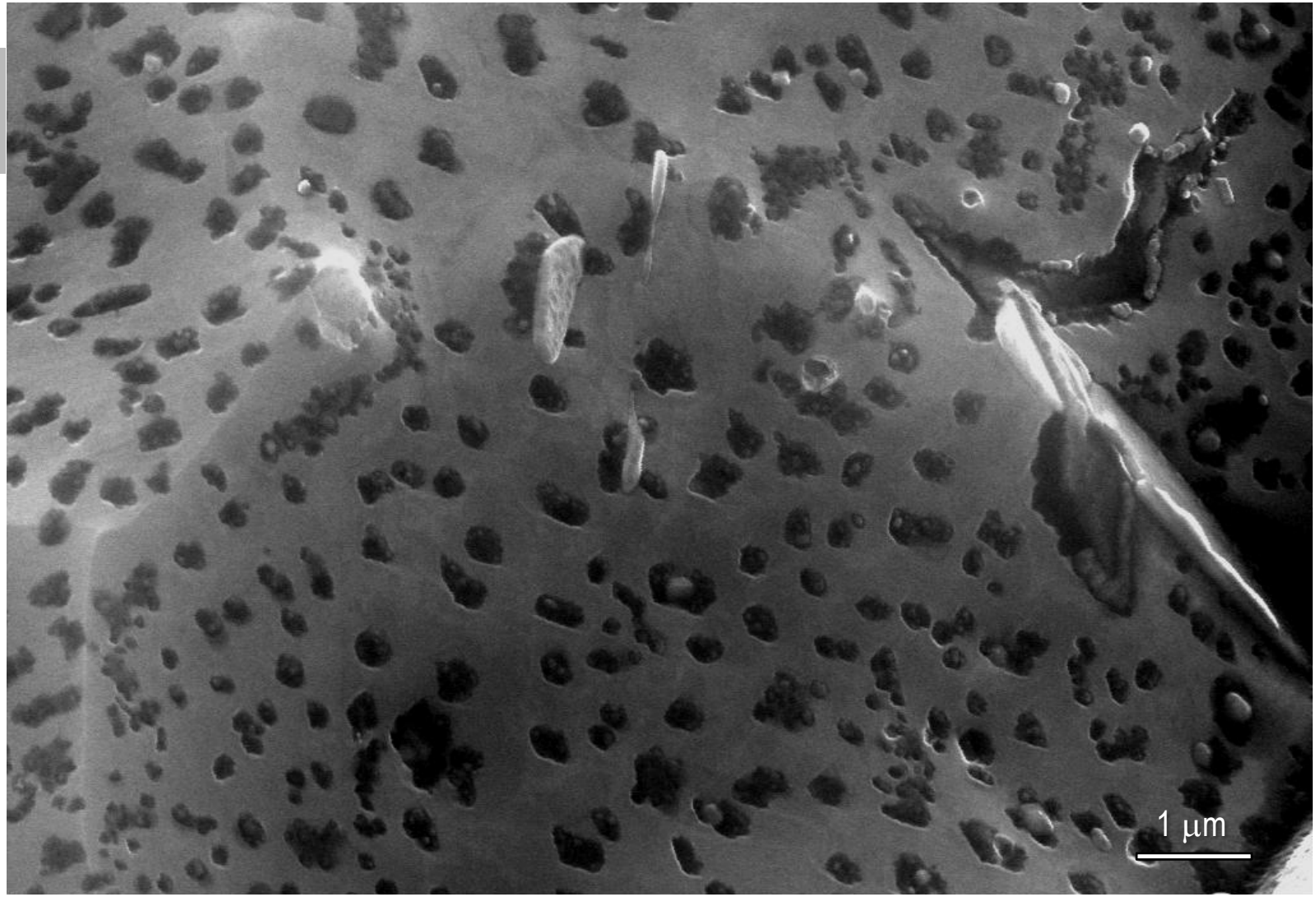

Water corrosion of AlMg3 during irradaition

5.2 dpa

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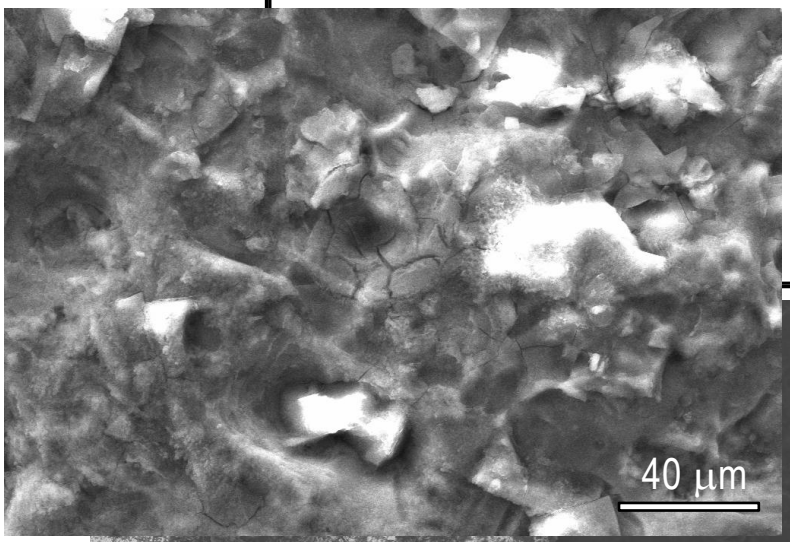

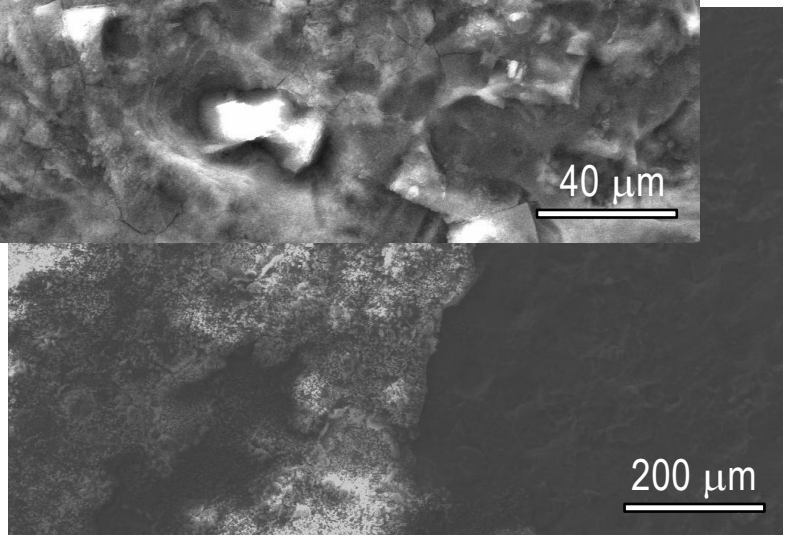

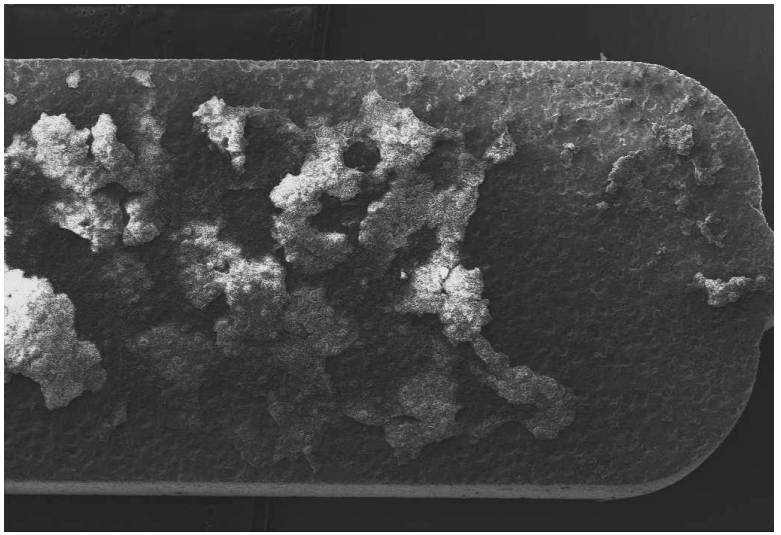

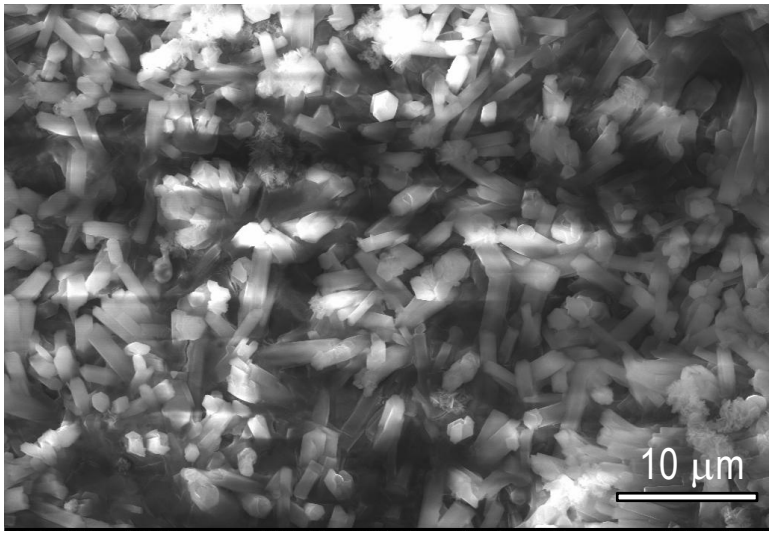

Water corrosion of AlMg3 during irradaition

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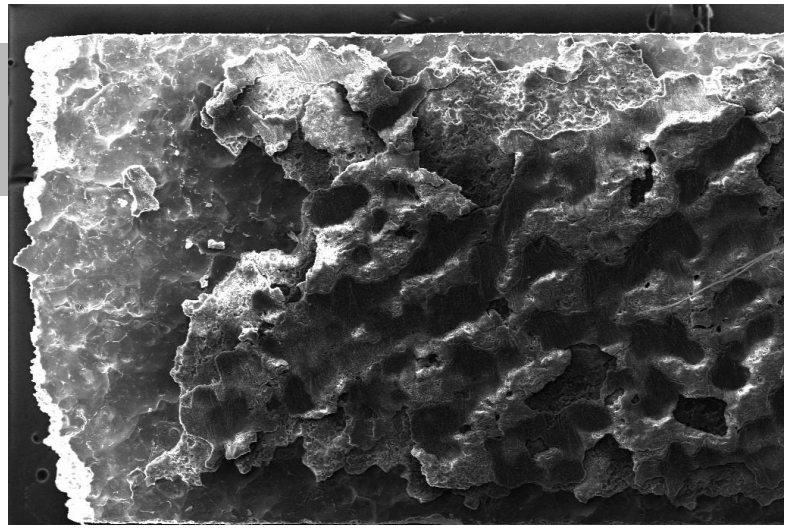
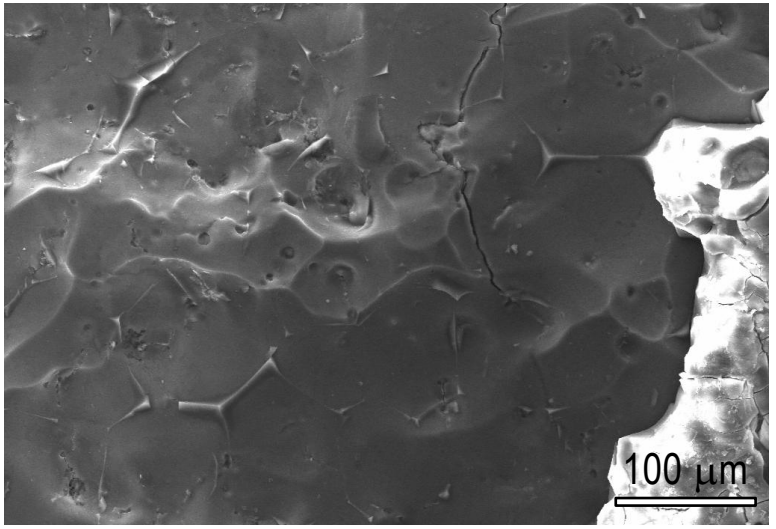
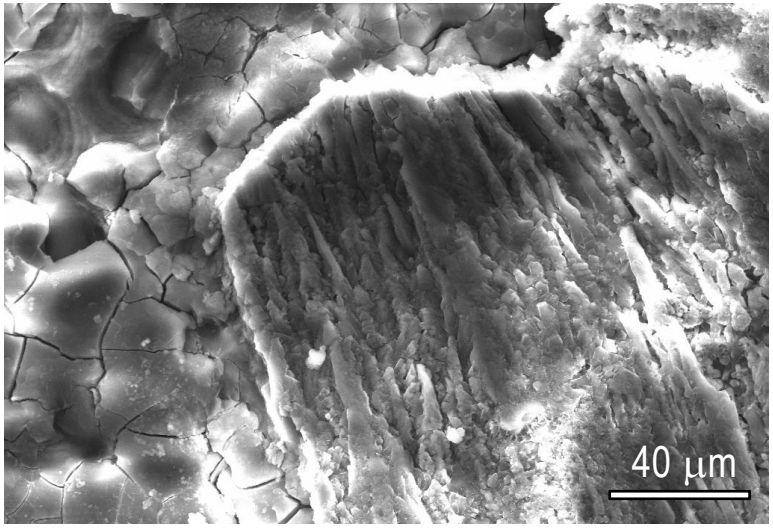
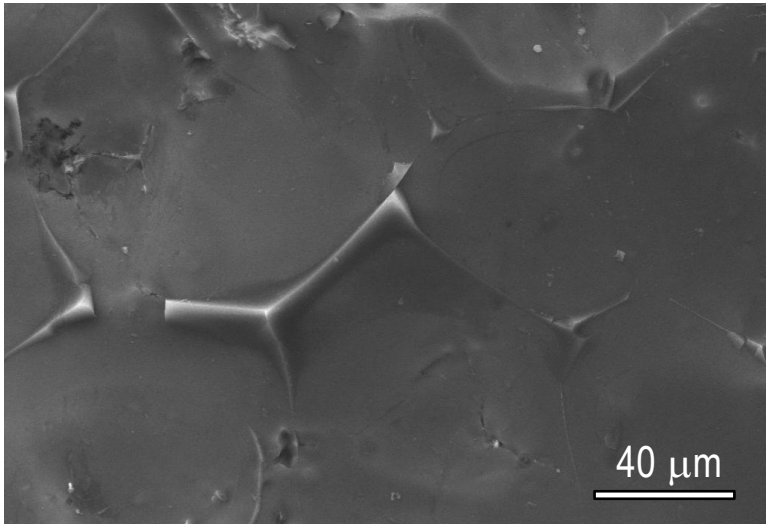






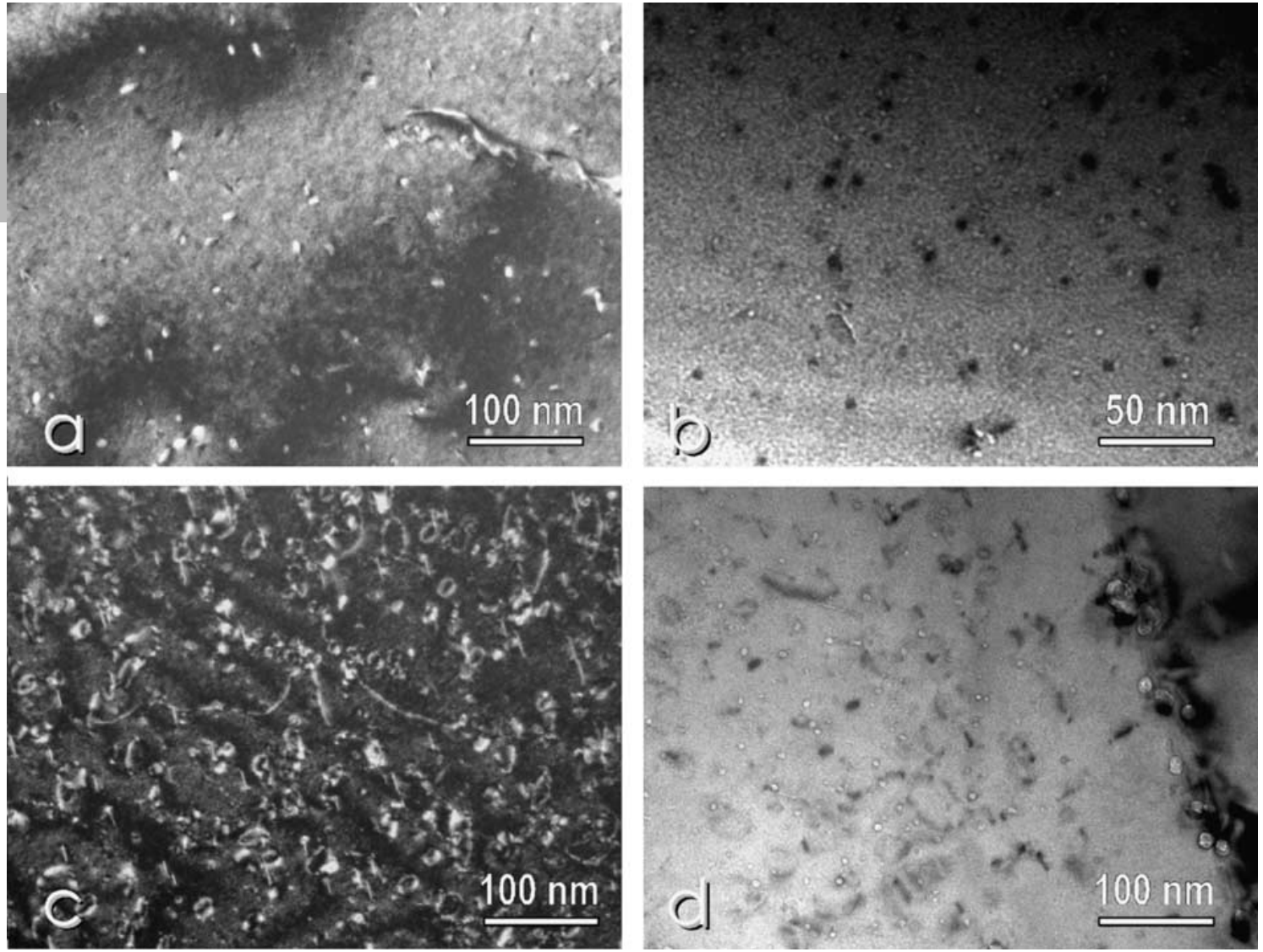


Conclusion

Preliminary conclusion:

The maximum proton charge acceptable for the AlMg3 safety-hull of the SINQ target is about 10 Ah, which is corresponding to 2-year operation at about 1.2 mA proton beam current at SINQ target.

Outlook: microstructural analysis



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