Effects of Room Temperature Aging on Hydrogen-Charged Nitinol

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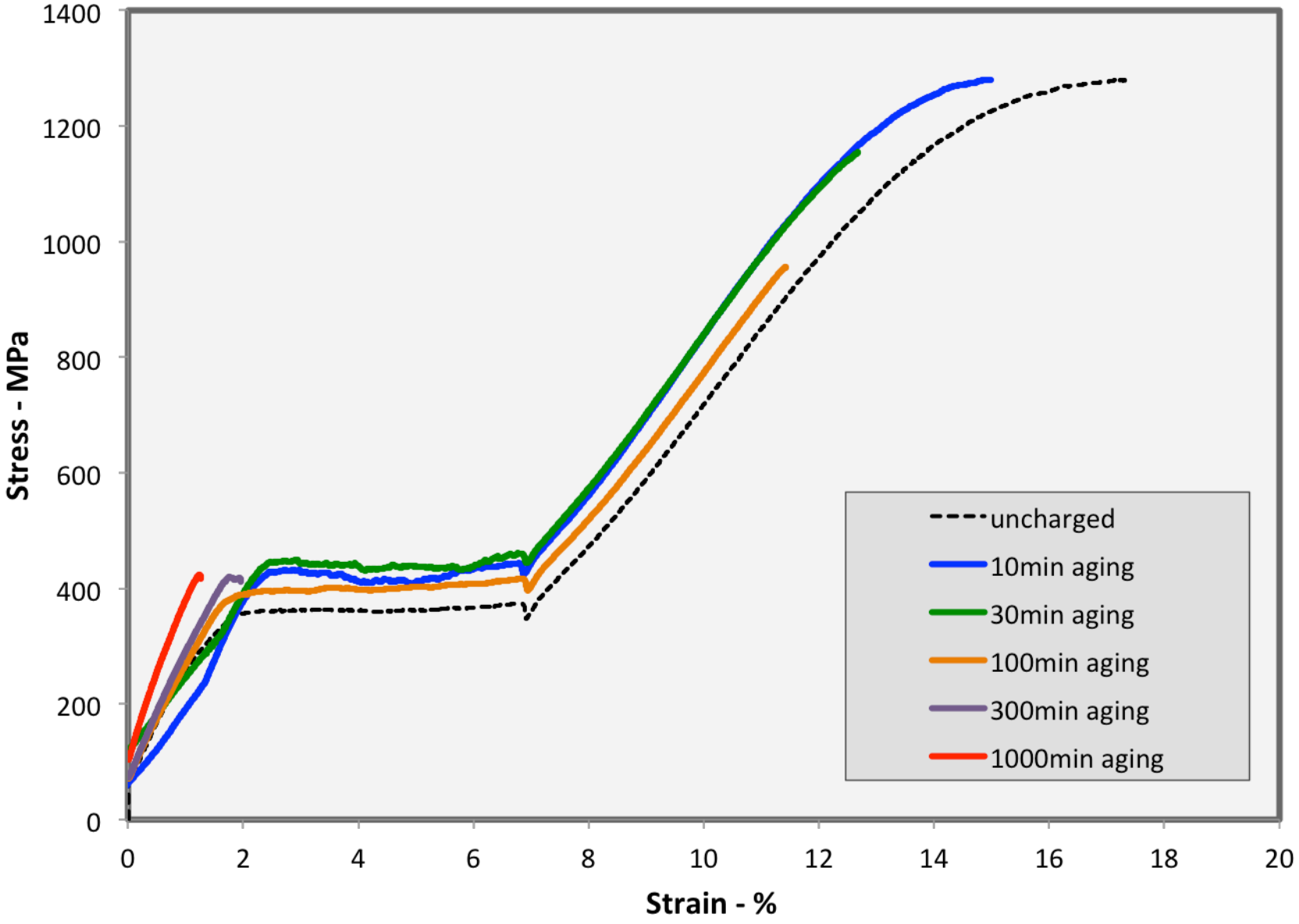
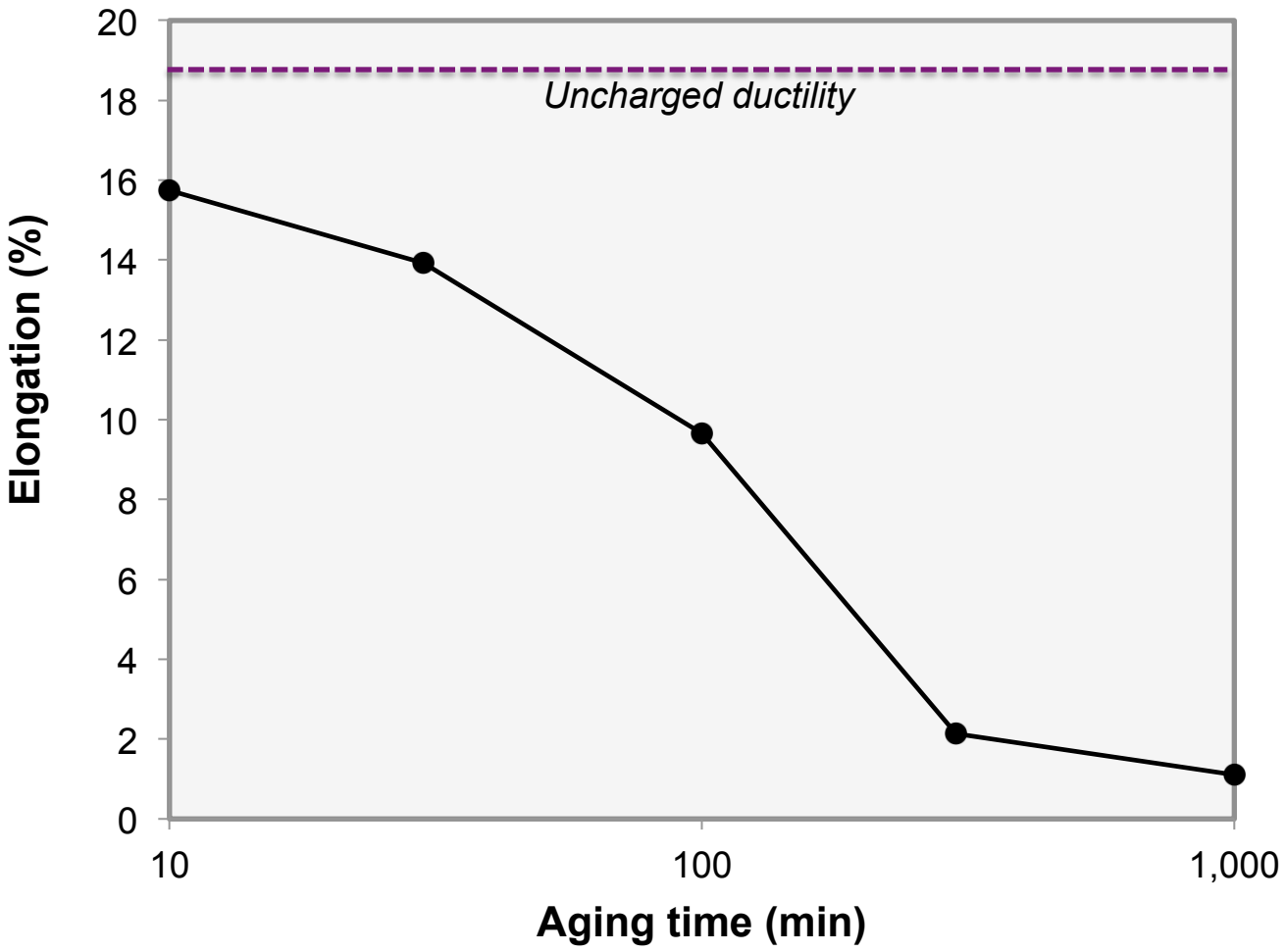
Experimental:

- Charging:
  - 95% methanol - 5% sulfuric acid
  - T = -10°C
  - 30 volts
  - Reversed polarity after 60 sec EP to charging
  - Variable time (30-90 seconds) to control hydrogen uptake
- Hydrogen measured by extraction using a Leco DH603 analyzer
- All tensile tests done in triplicate on “dogbones” made from ϕ1.0mm wire

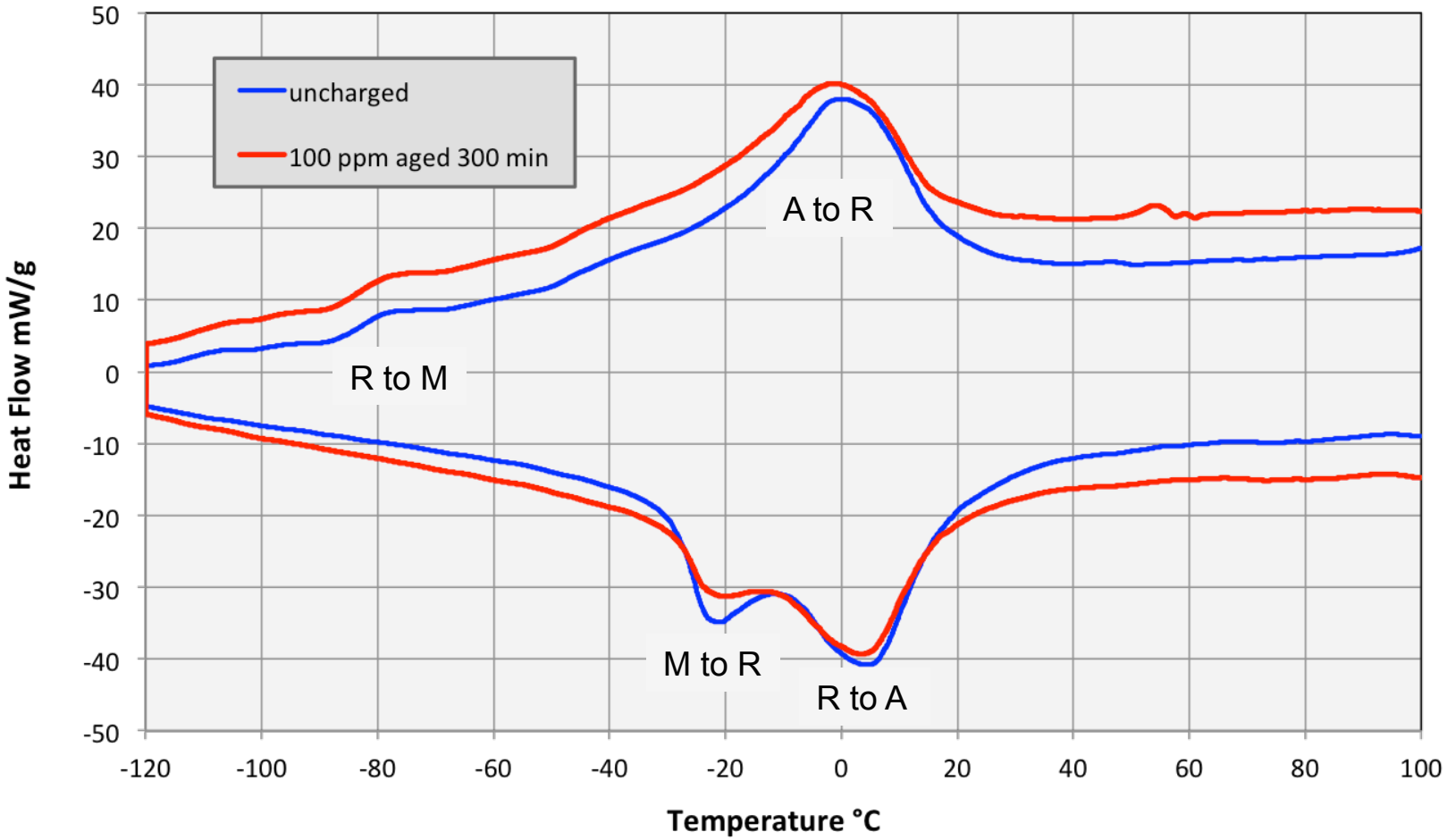
Embrittlement effects:



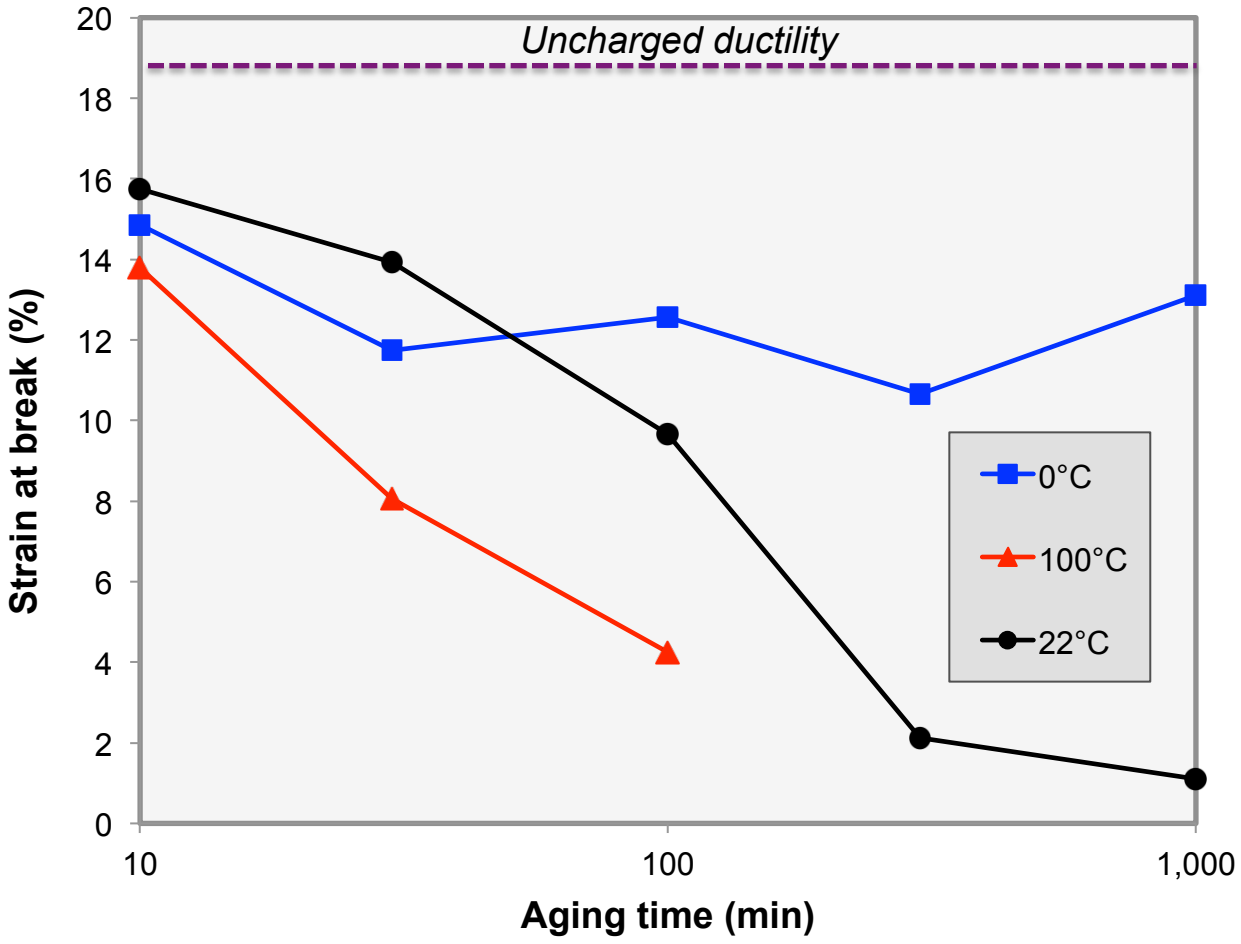
Aging at room temperature: 150 wt. ppm H



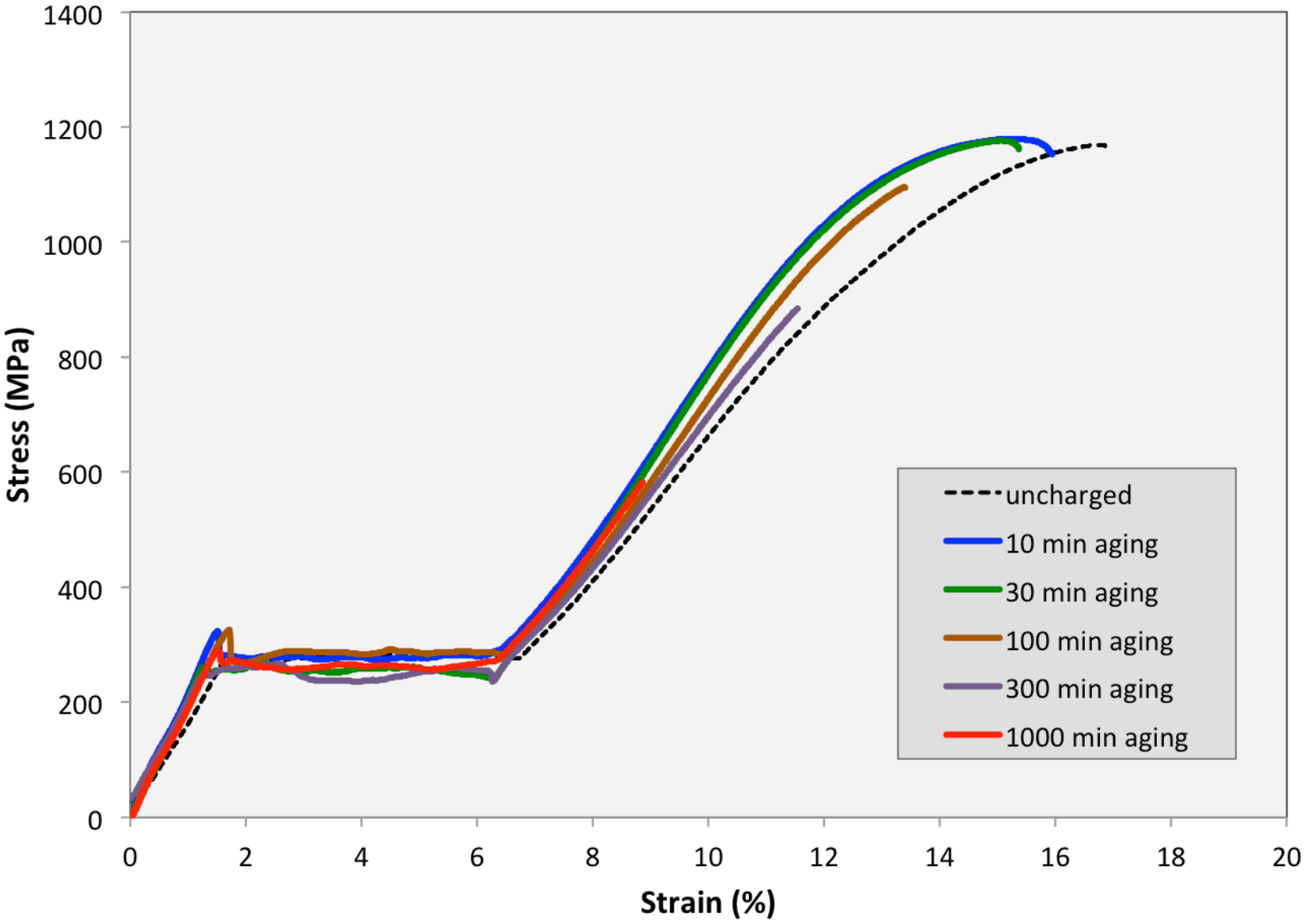
DSC: No significant changes to any of the transformation temperatures during ageing



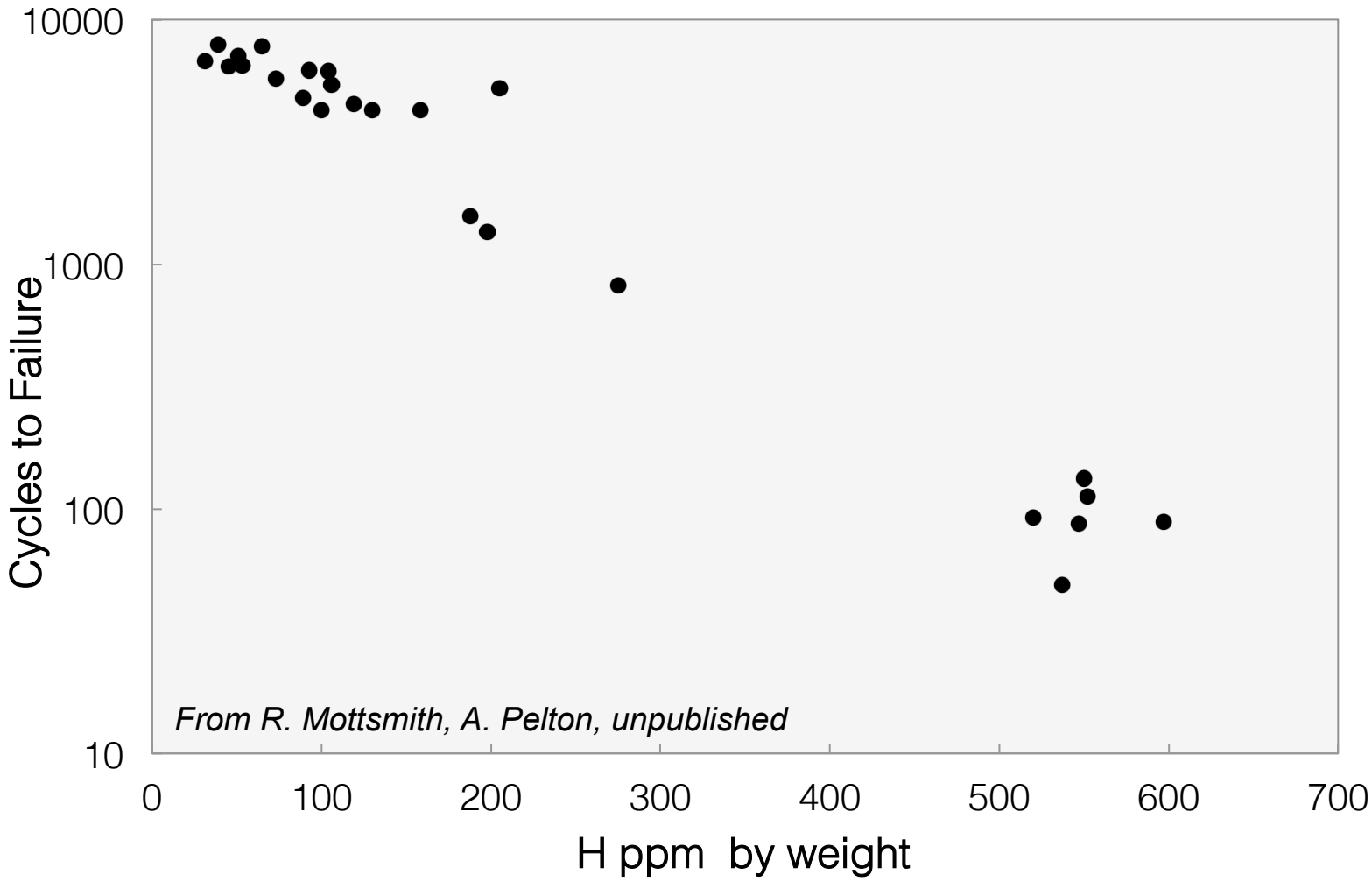
Effect of aging temperature: 150 wt. ppm H



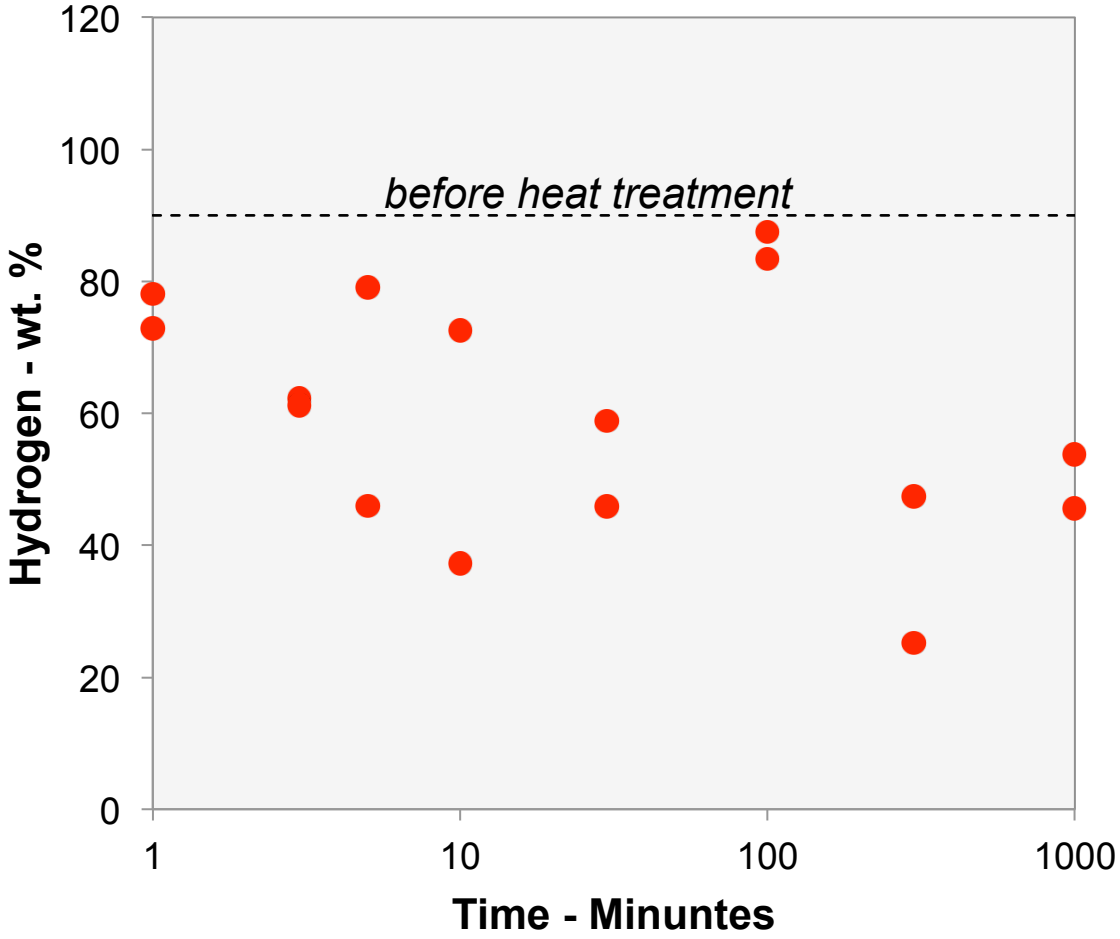
Charged to 20-50 ppm and aged at RT



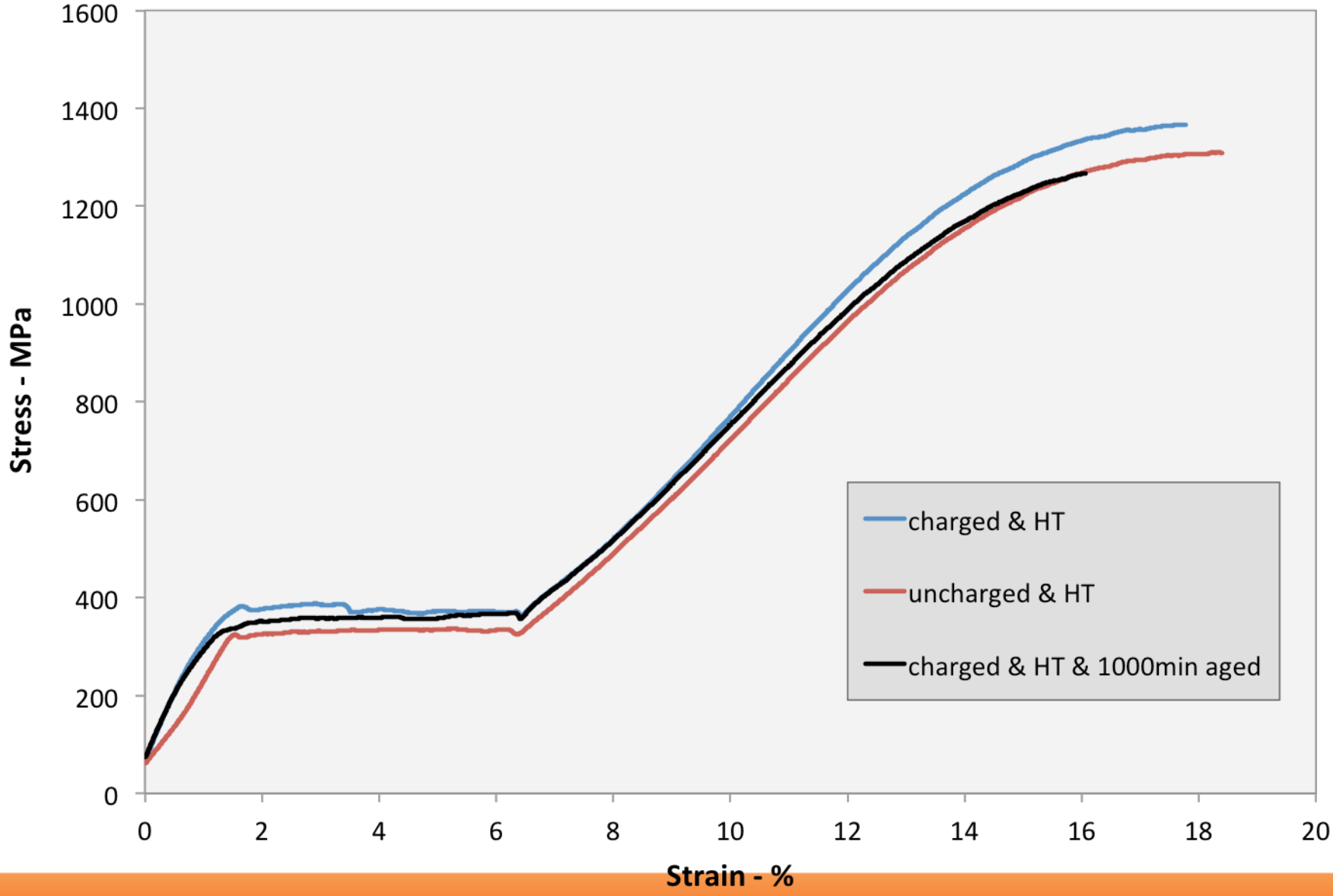
Impact of hydrogen on RB fatigue—need to control ageing time



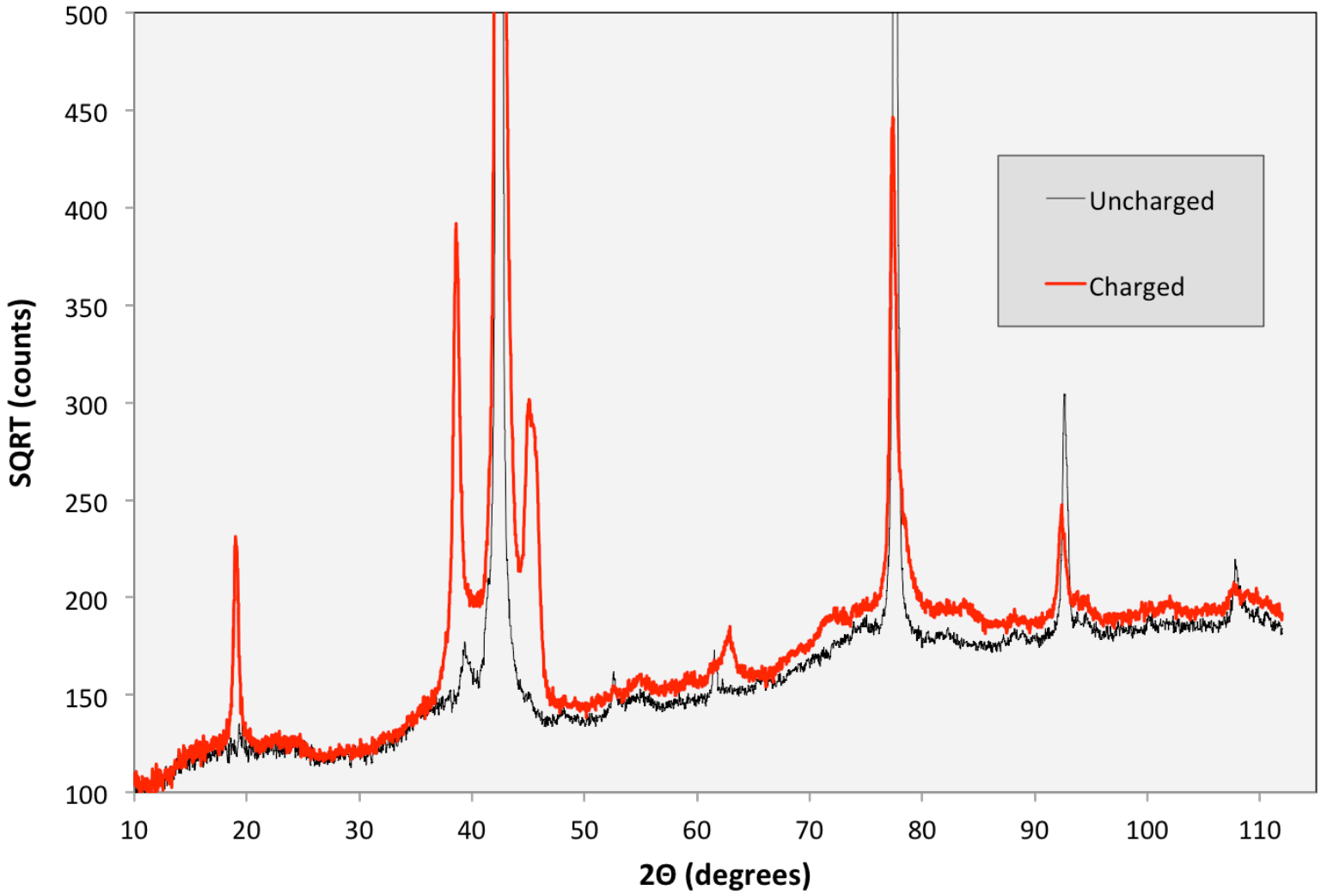
Heat treatment (5 min at 500°C) after charging to 100 ppm



Heat treatment after charging—appears to negate ageing effects (hydrogen levels unchanged)



X-ray diffraction

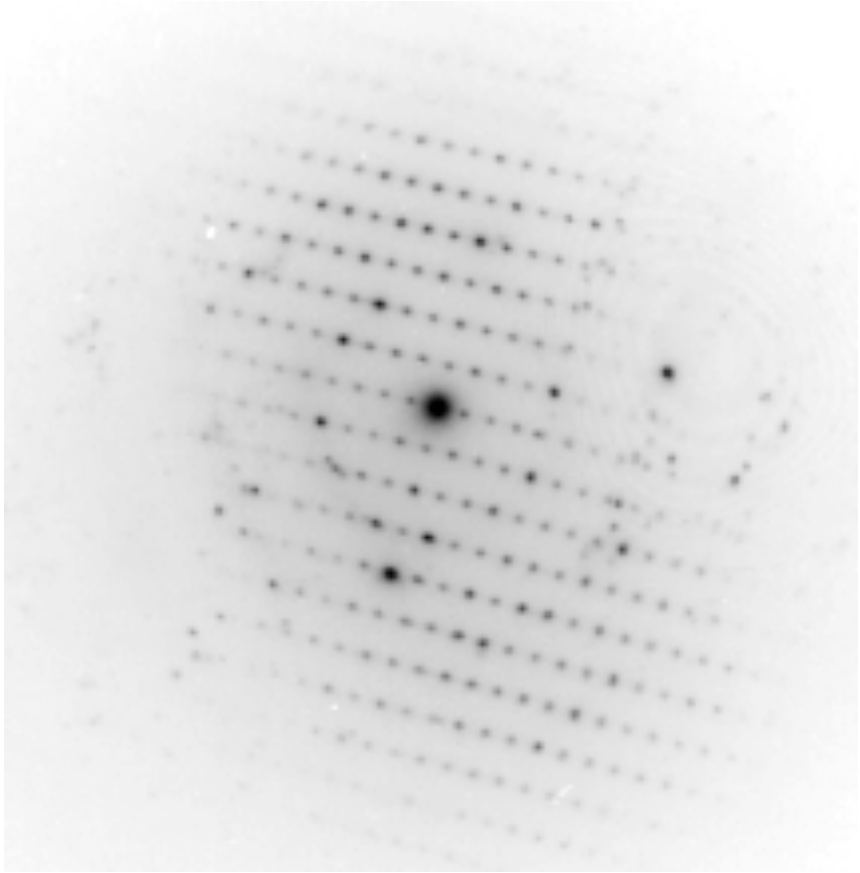


X-ray diffraction
(d-spacings in Angstroms)

uncharged	charged	Pelton et al
	4.67	**4.70**
		2.38
	2.33	**2.35**
2.13	2.10	2.14
	2.00	**2.01**
1.23	1.23	1.24
1.06	1.07	

1 A. Pelton, et al, ASM Mater. Proc. Med. Dev. Conf (2003)

TEM-SAD:
Complicated and inconclusive, very large cell, does not appear to be cubic



Appeal for follow-on work

- Assure that RT aging effects are taken into account in all future hydrogen studies.
- Identify hydride structure
- Measure diffusivity at RT
- Identify mechanism of RT aging (hydride formation, diffusion, congregation)
- Define more precisely the effect of HT on hydrogen and ductility