



Magnesium Diffusion and Flux Interactions During Controlled Atmosphere Brazing

By

Alan Gray and Hans-Walter Swidersky*

Innoval Technology Limited & Solvay Fluor*



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- Introduction
- Why add magnesium?
- Pre-existing oxide - surface and sub-surface
- Mg Diffusion - braze cycle
- Sumitomo work - core/clad Mg interaction
- Summary
- Future work



Why Add Magnesium?



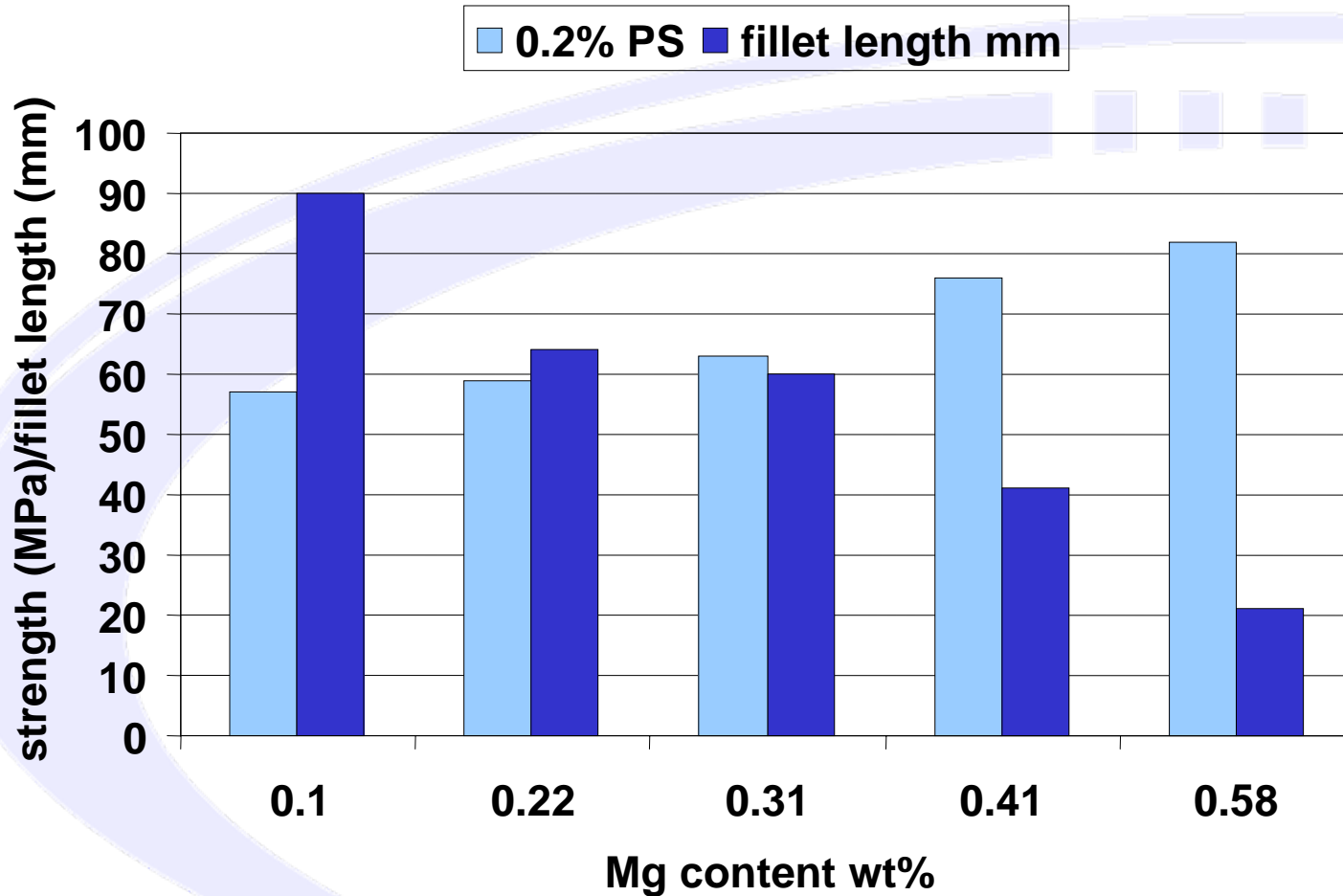
- potent solid solution strengthening
- does not limit absorption of process scrap
- no ELV limitations on recycling

.....However:

- flux 'poisoning'
- increased flux consumption or
- alternative flux packages



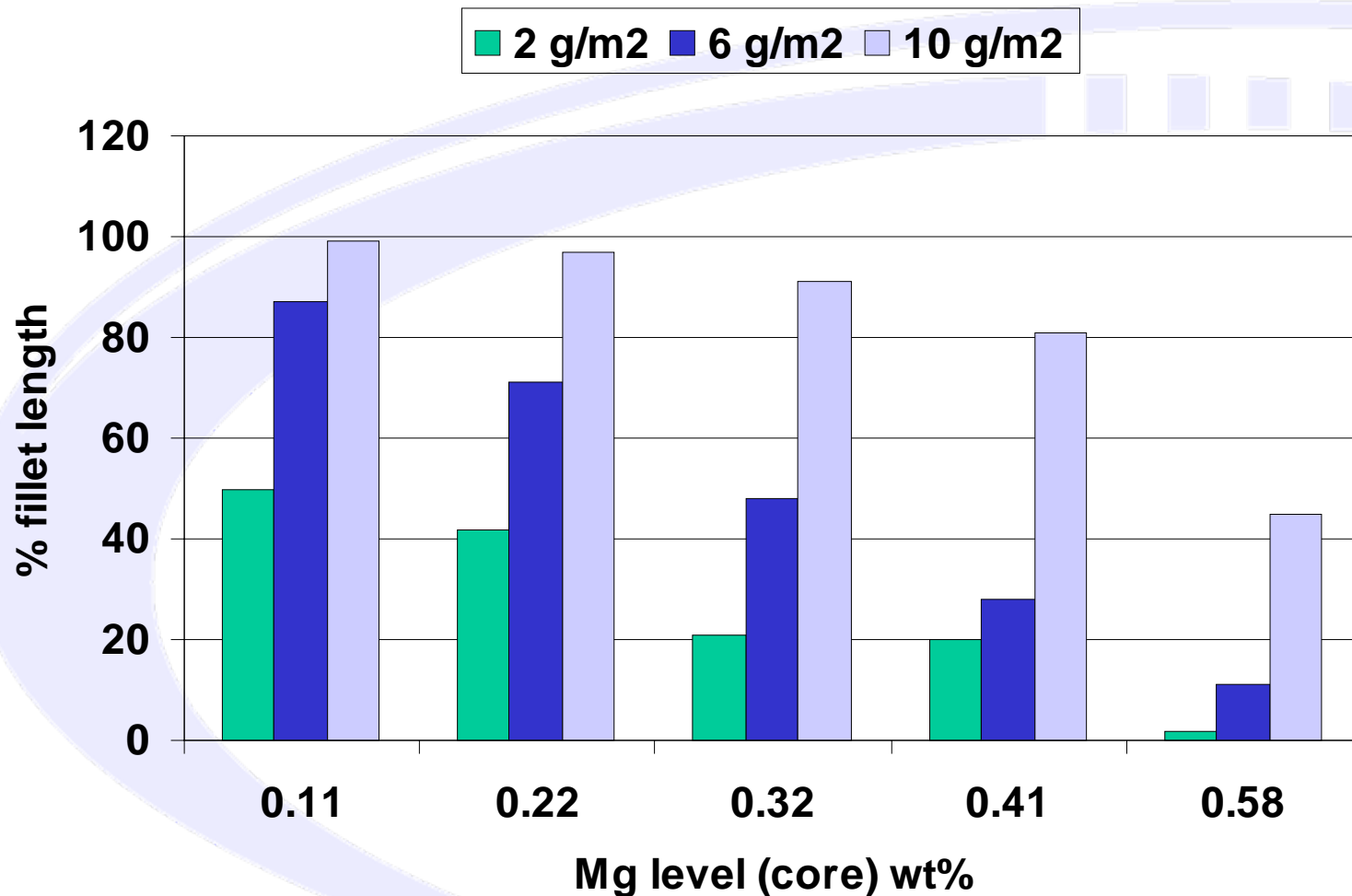
Influence of Mg Additions:



Gray et al, AFC Brazing Seminar October 1998



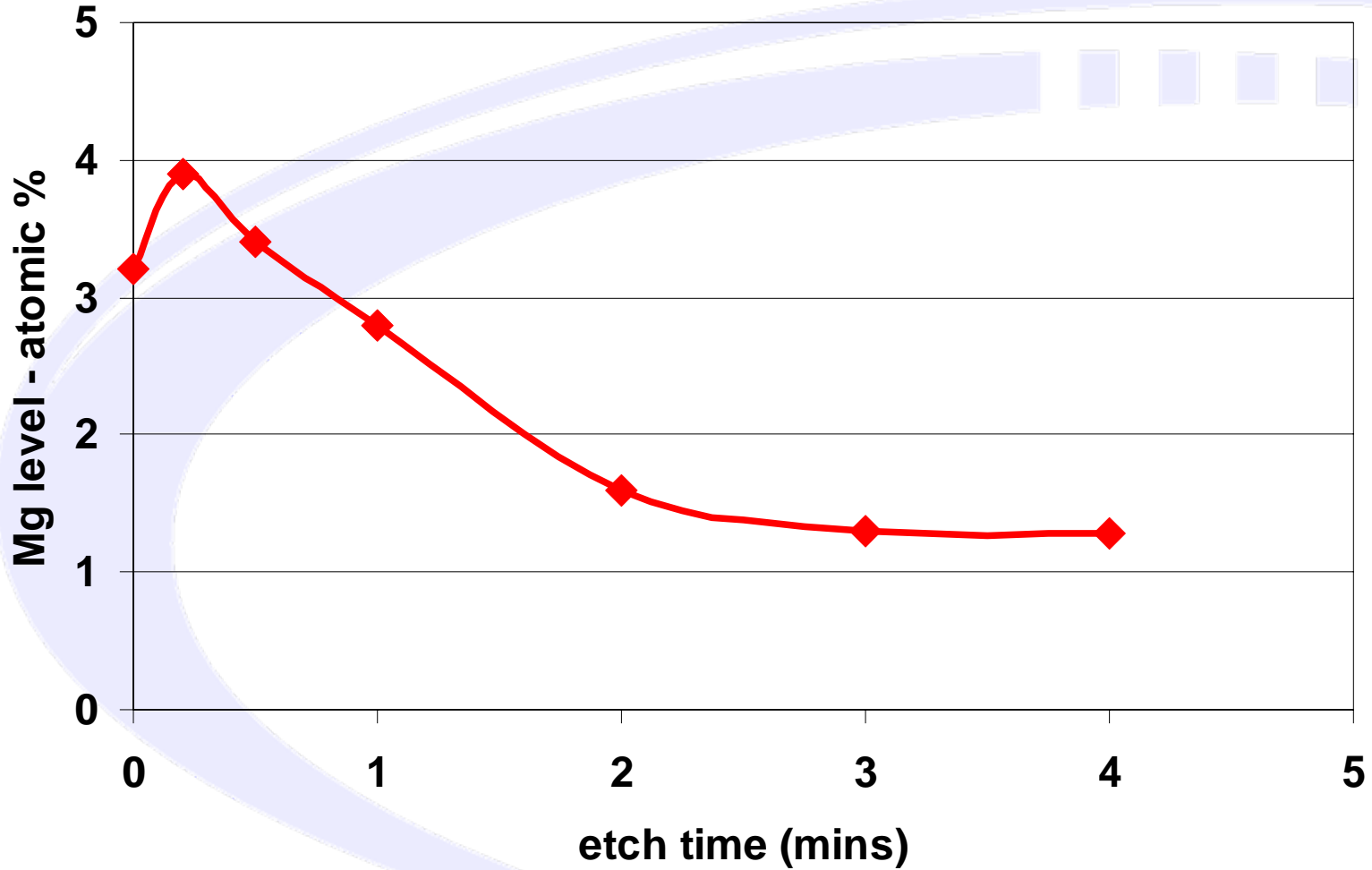
Influence of Mg Additions:

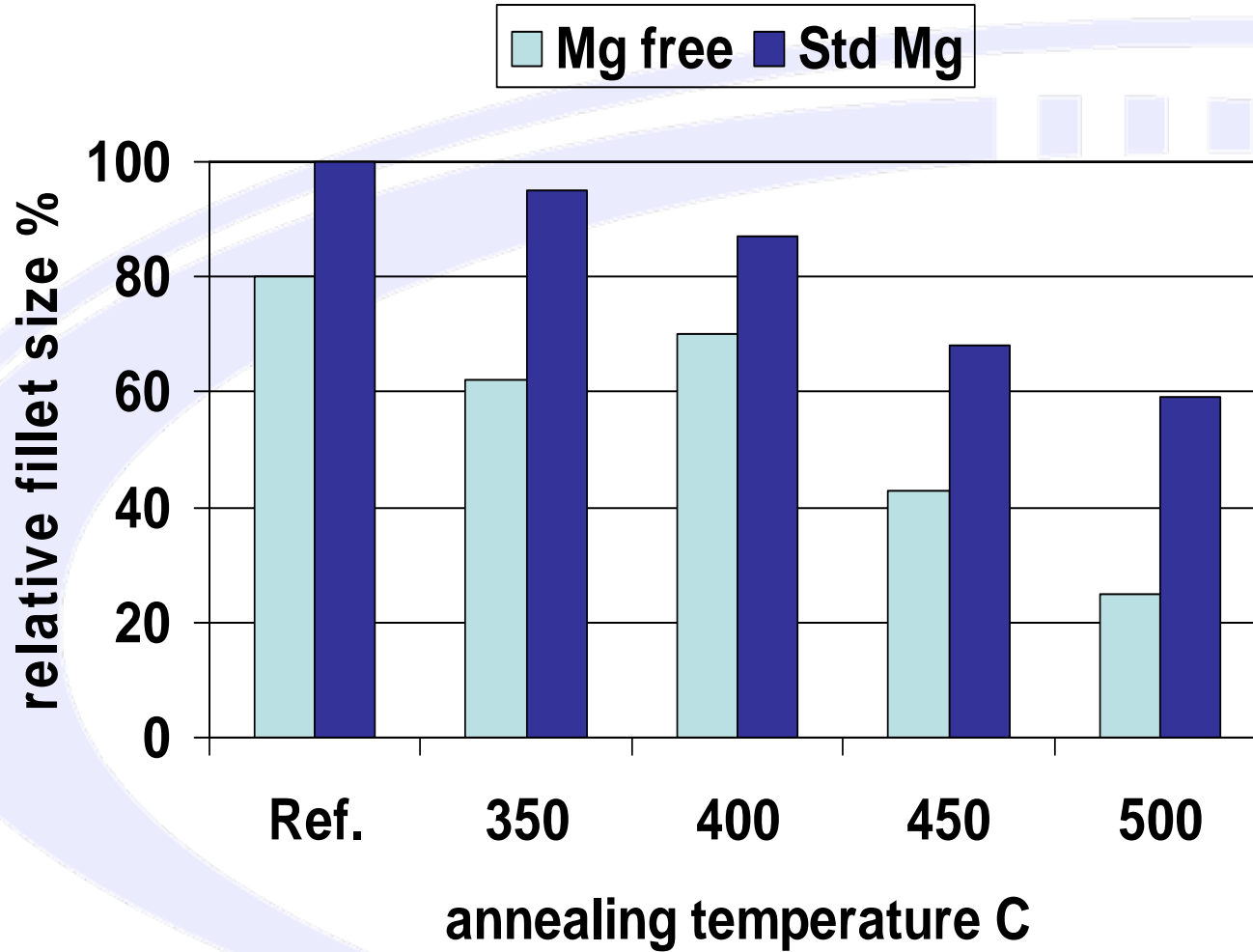


Lauzon et al, AFC Brazing Seminar October 1998

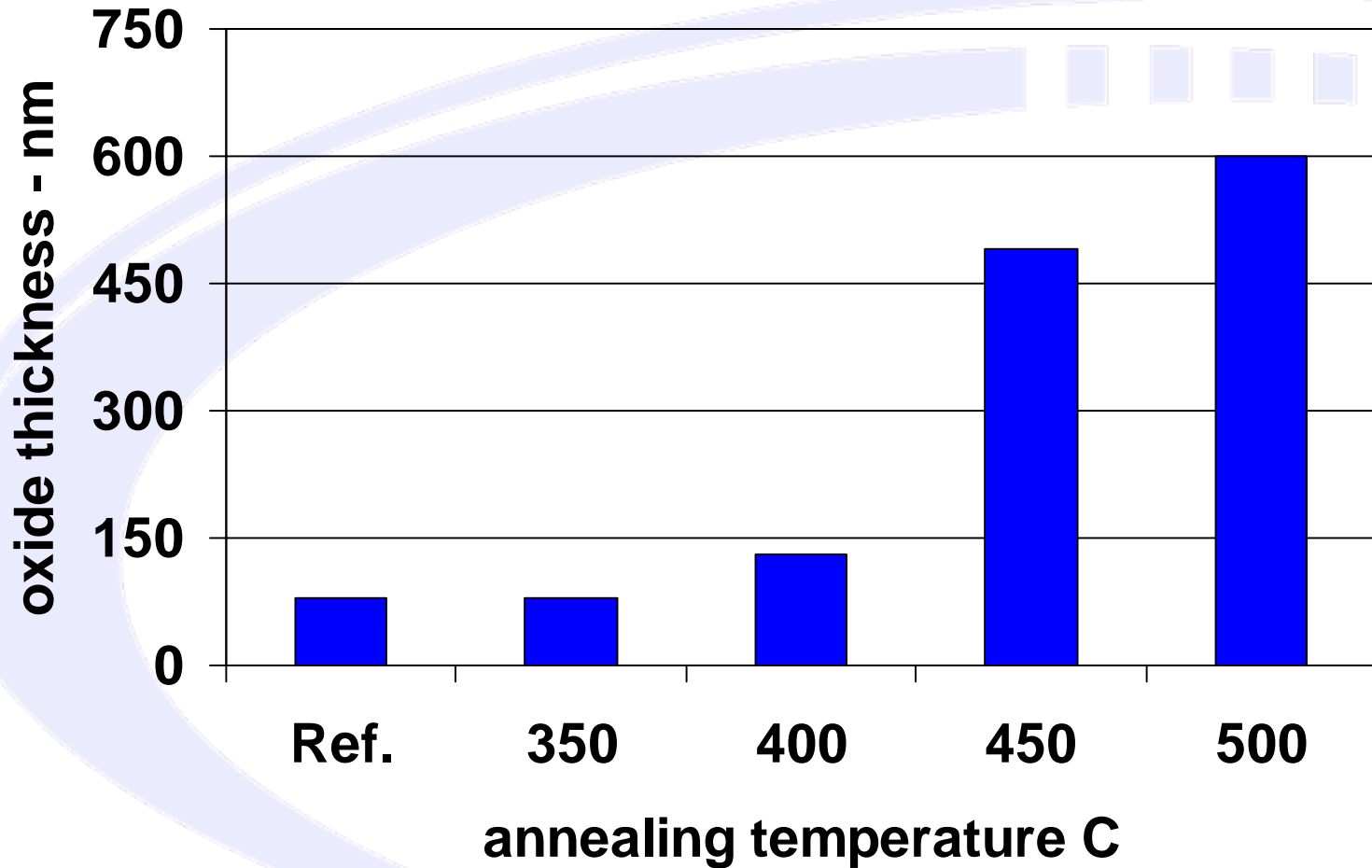


Mg Profile After Batch Anneal

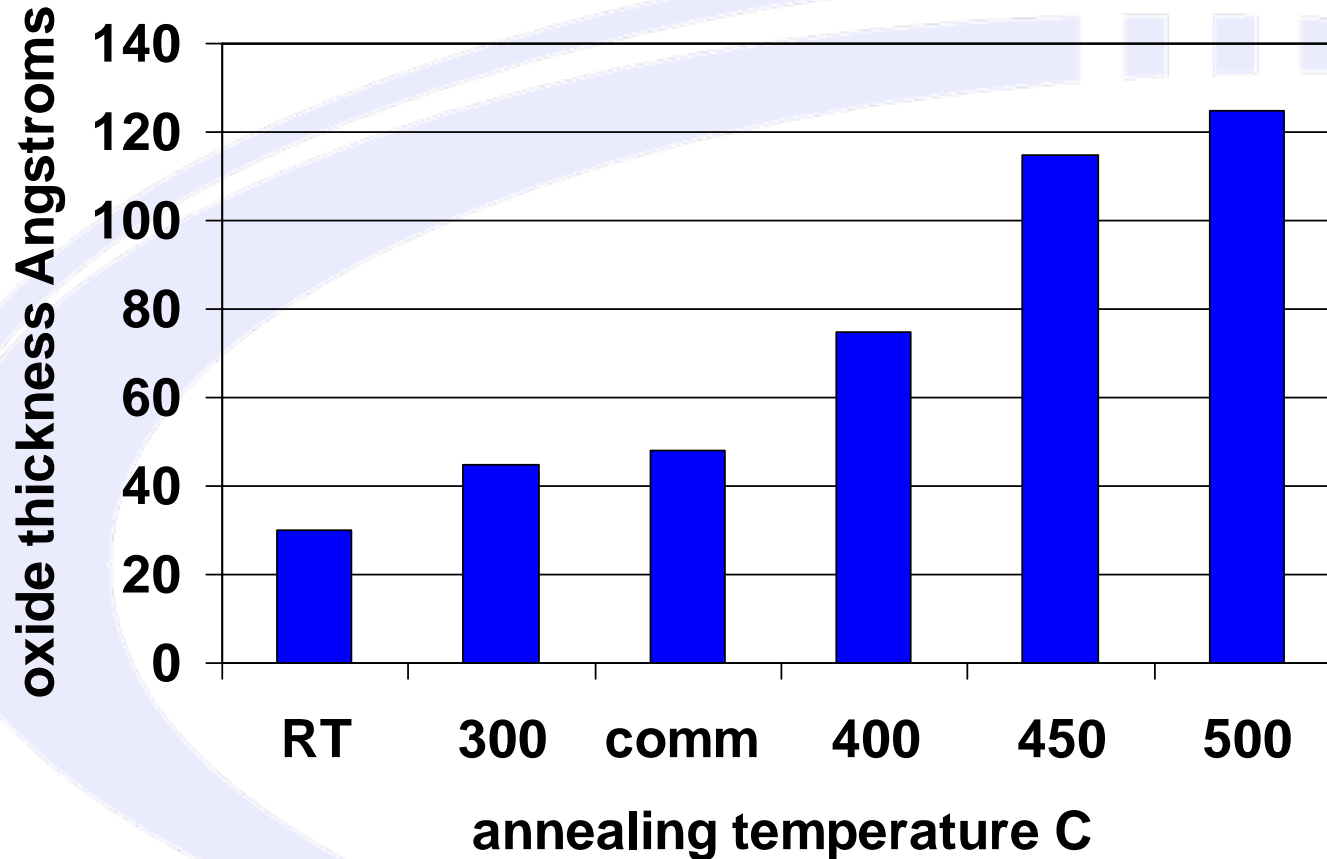




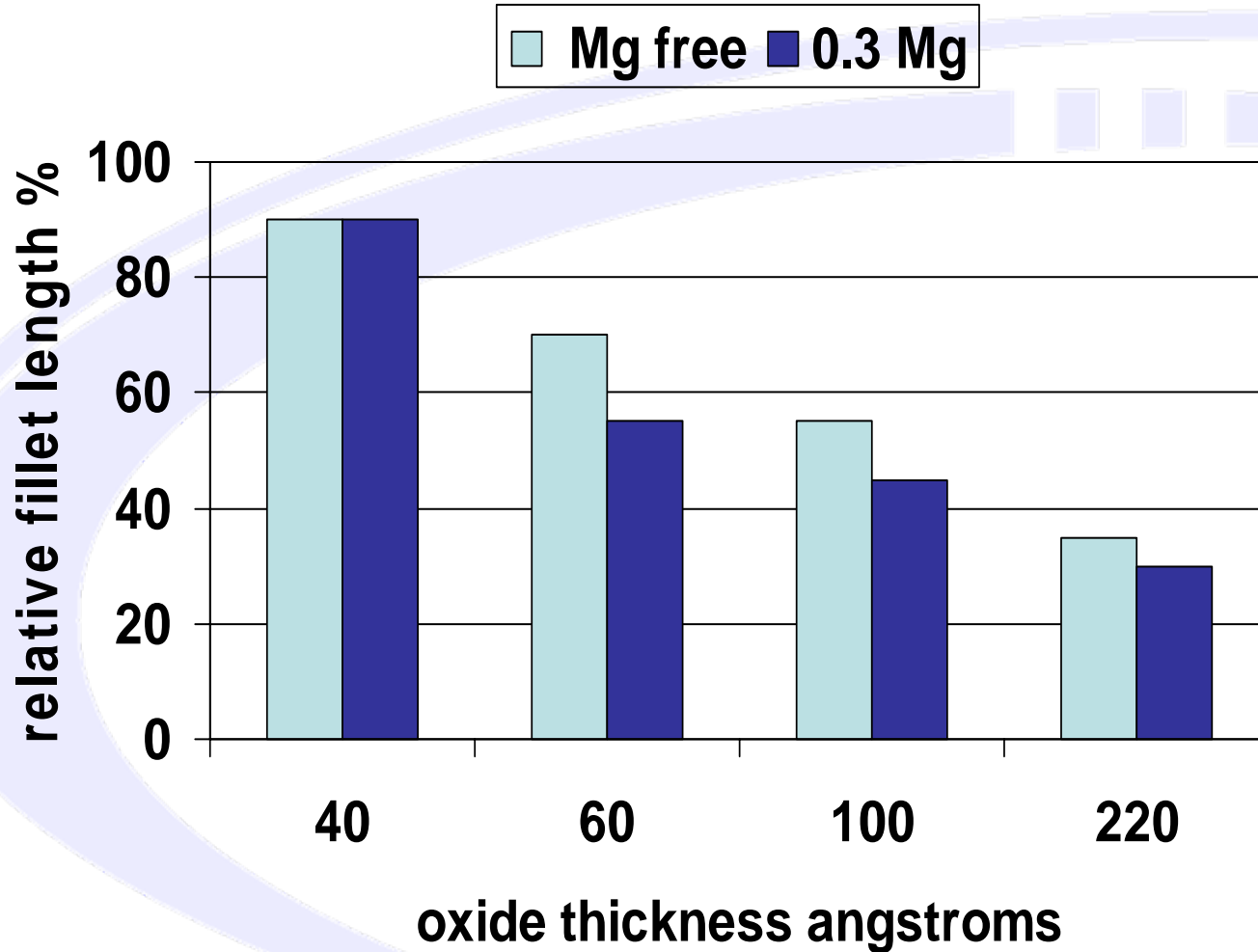
Wittebrood et al, Corus
SAE 1971



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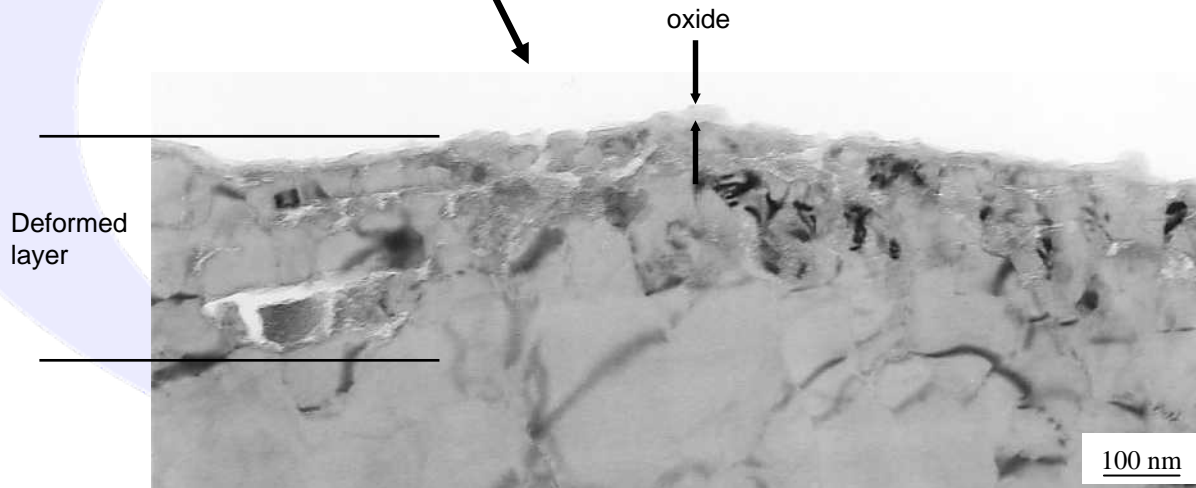
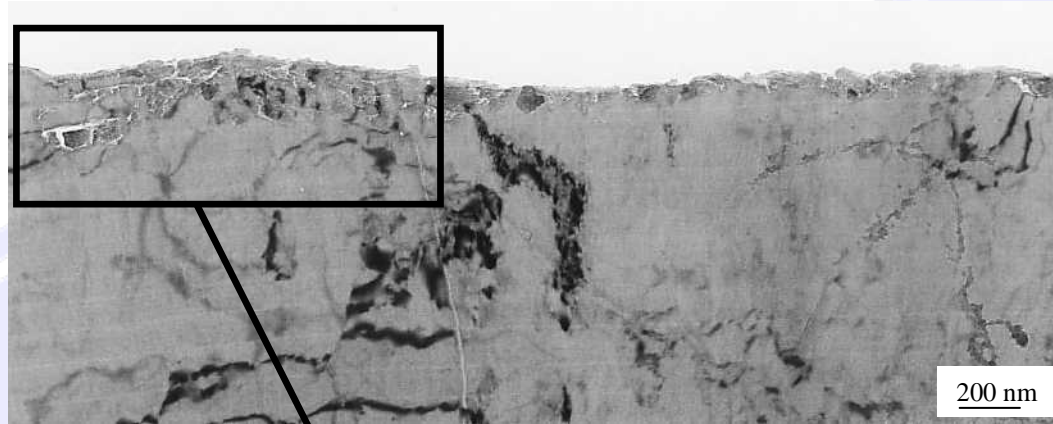
*Olefjord et al,
SAPA 4th International Conf. 1994*



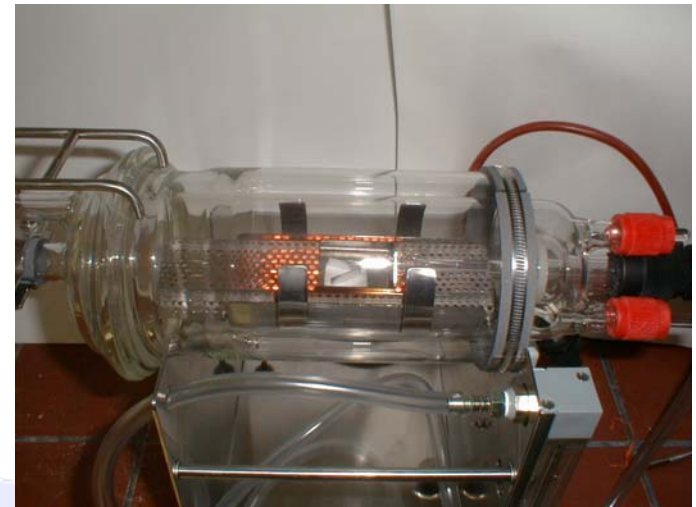
Gray et al, Alcan
VTMS 1999

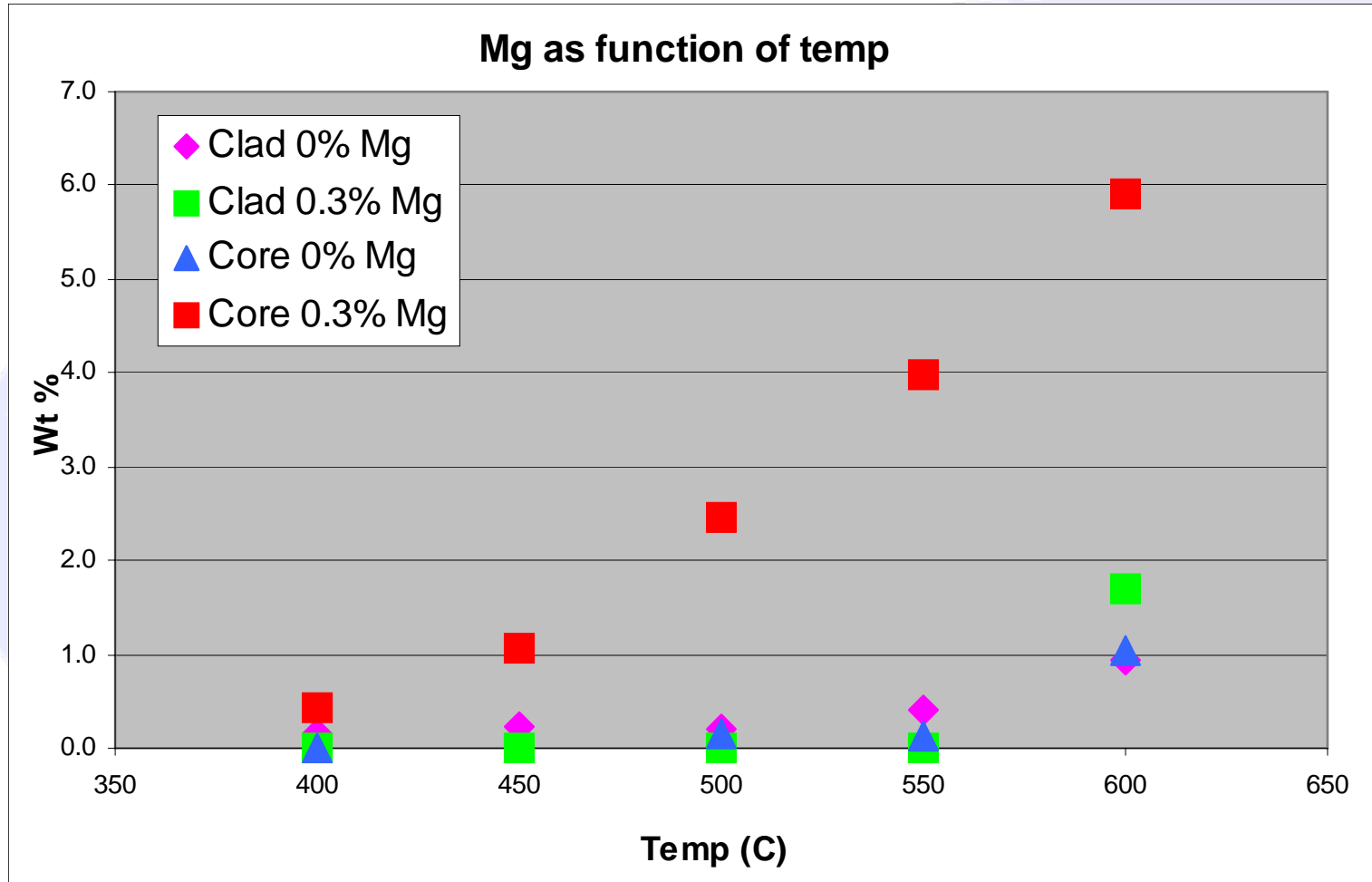


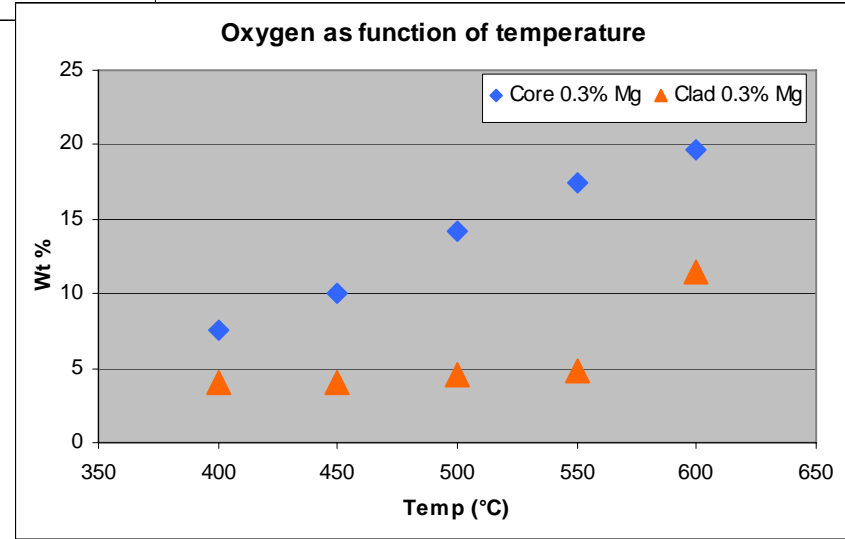
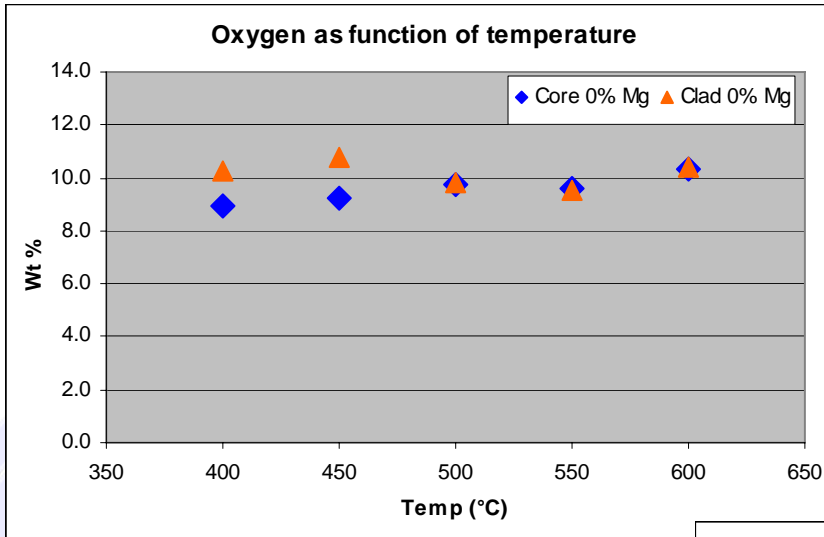
Sub-surface Oxide – ‘disturbed layers’



- 3003 core alloys with <math><0.1</math> and 0.31 wt% Mg
- Oxidation behaviour - 400, 450, 500 & 550°C
- Brazing cycle - 20 mins to 600°C and 2 min hold
- Flux load - 5 g m⁻²
- Laboratory tube furnace (Solvay Fluor)

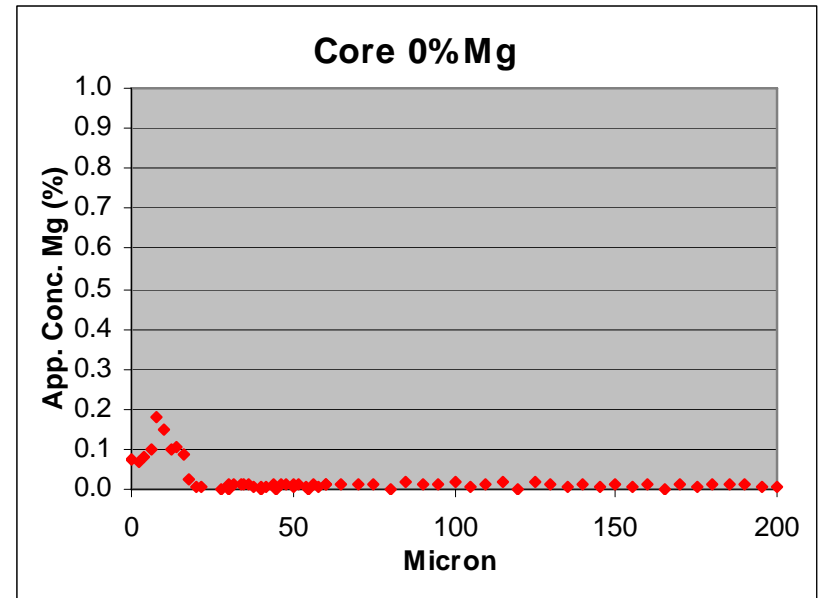
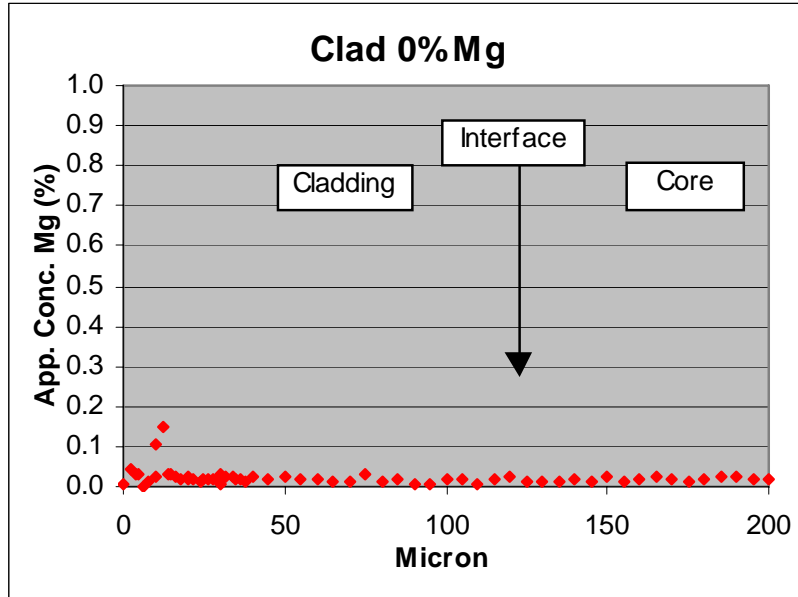






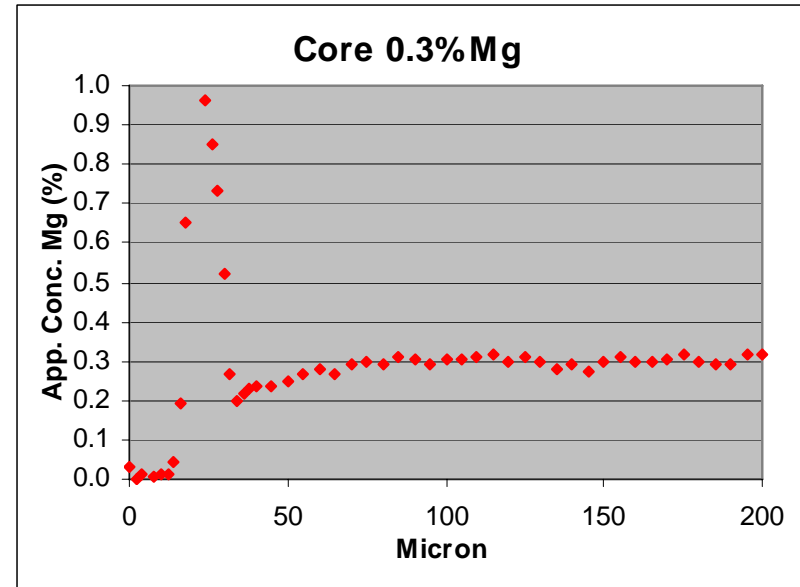
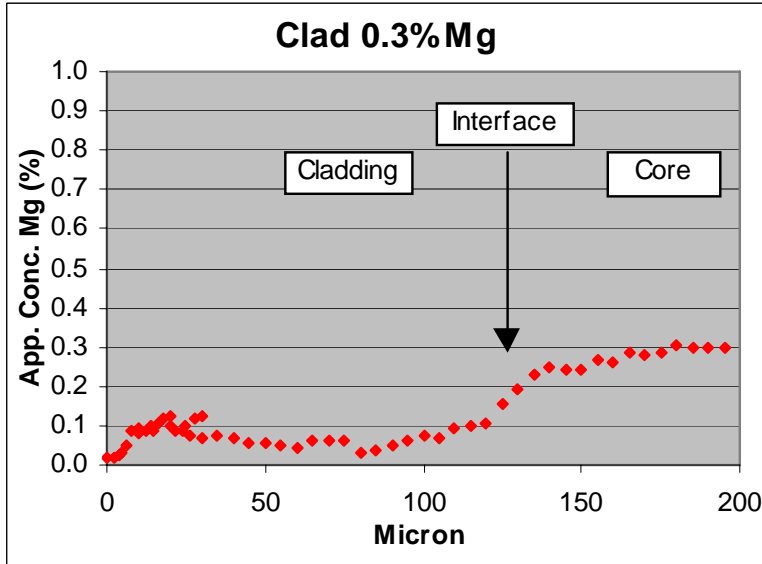


Mg Profiles - Clad/core Interface



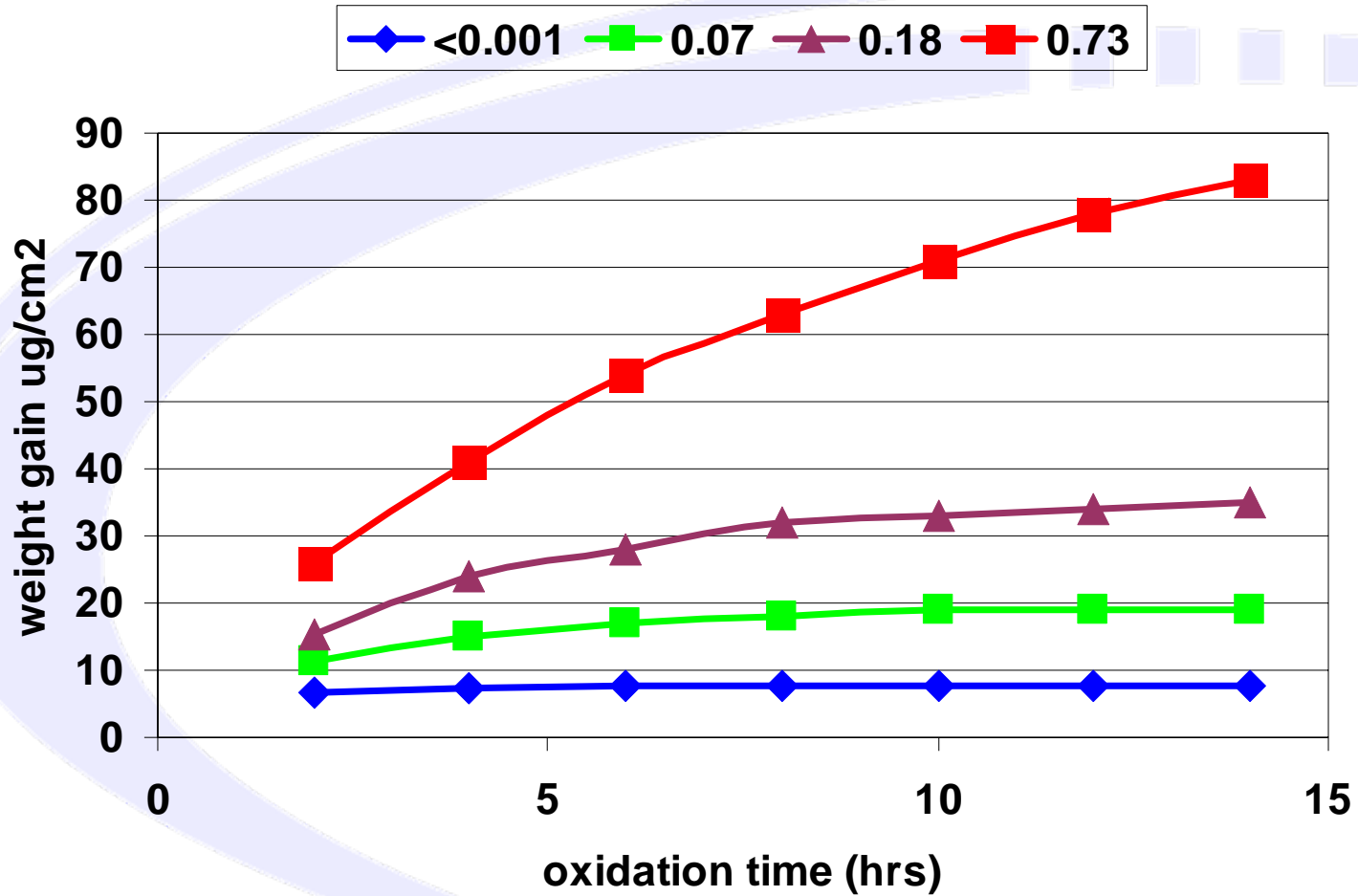


Mg Profiles - Clad/core Interface



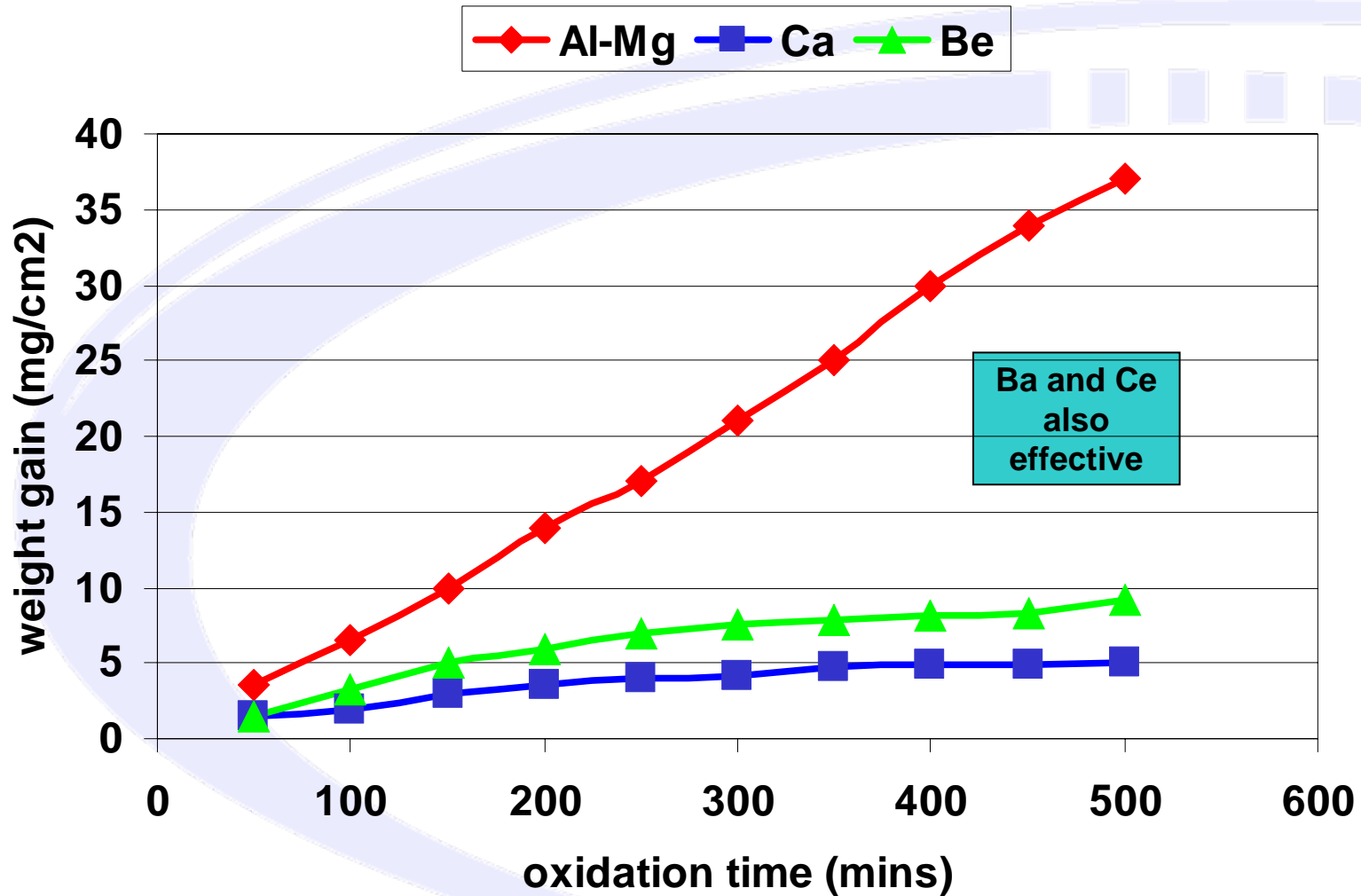


Al-Mg Alloys - Oxidation Rates at 595°C

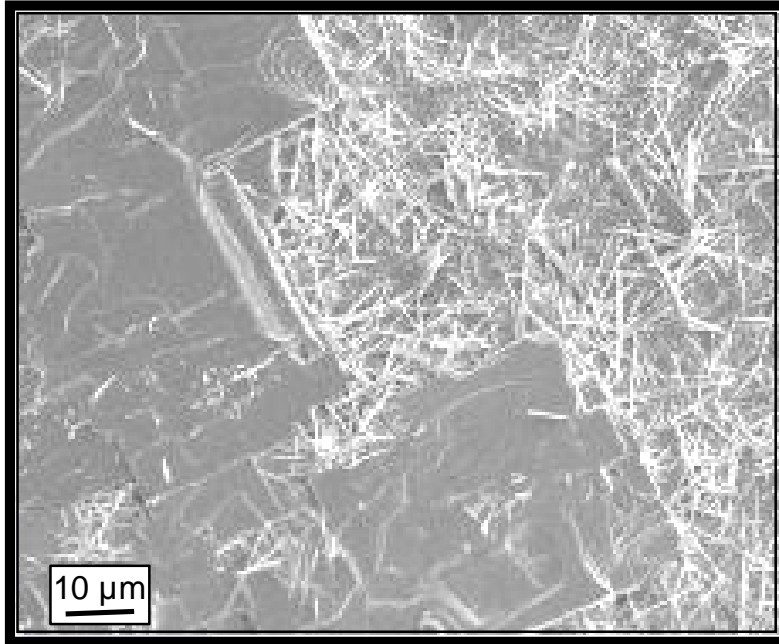




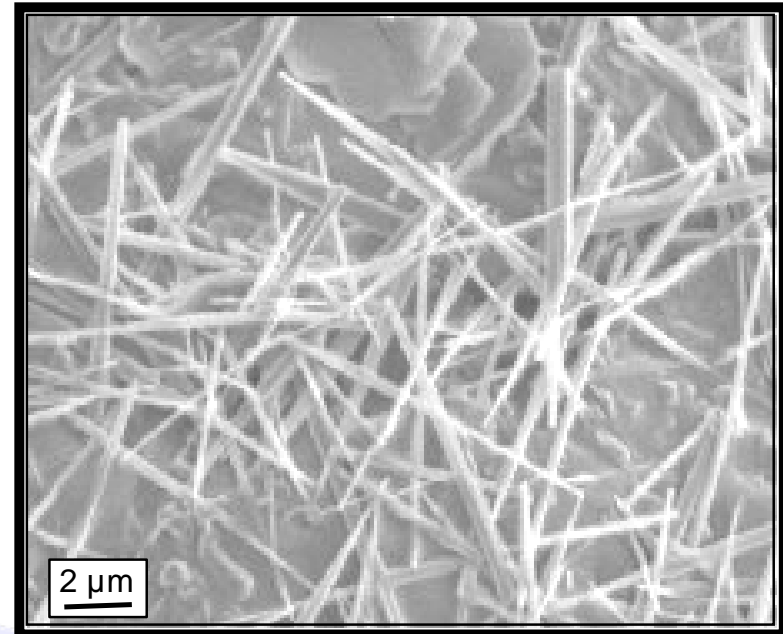
Oxidation Suppressants: 480°C

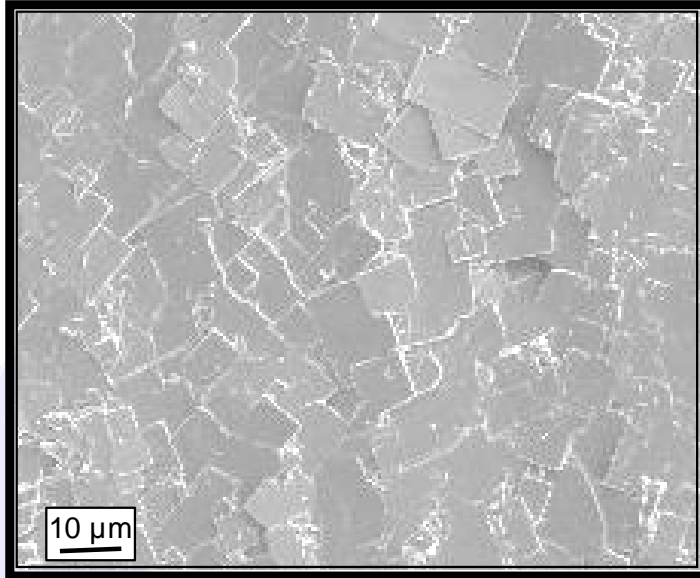


Field et al, Alcan International Ltd

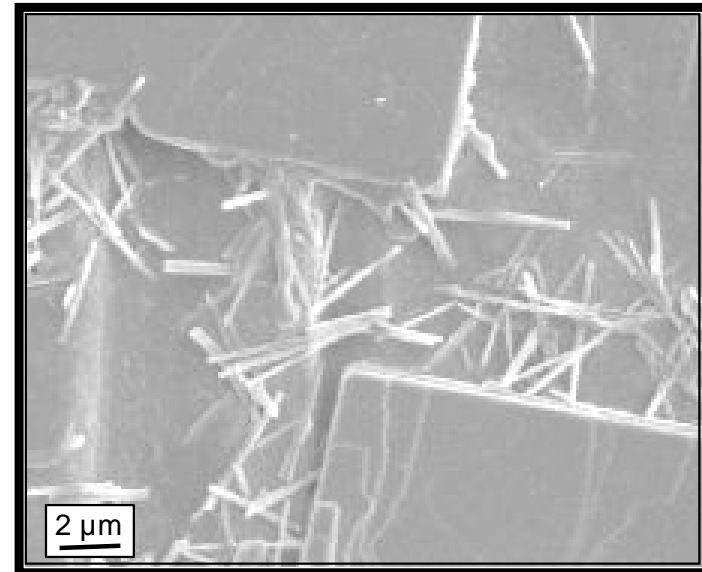


Clad Surface
<0.1 wt Mg core



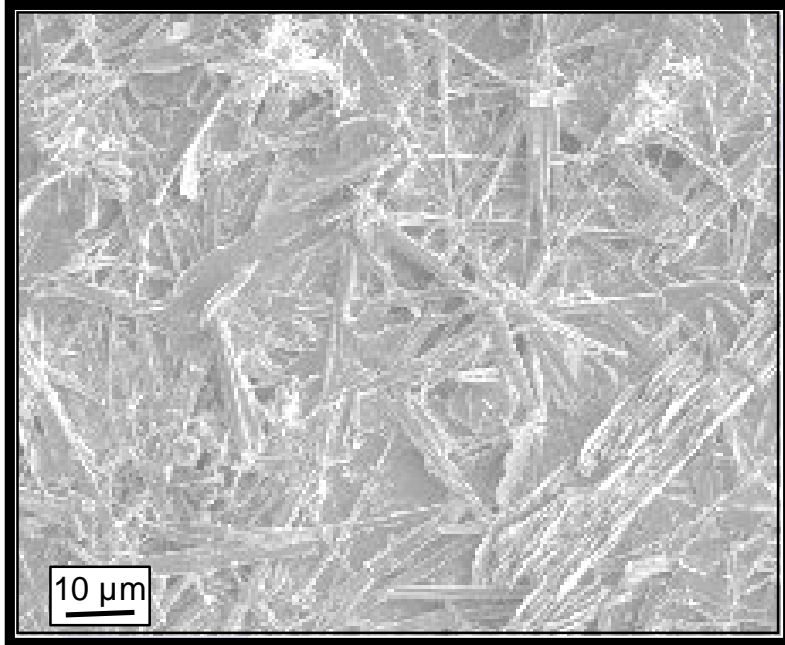


Core surface
<0.1 wt% Mg core

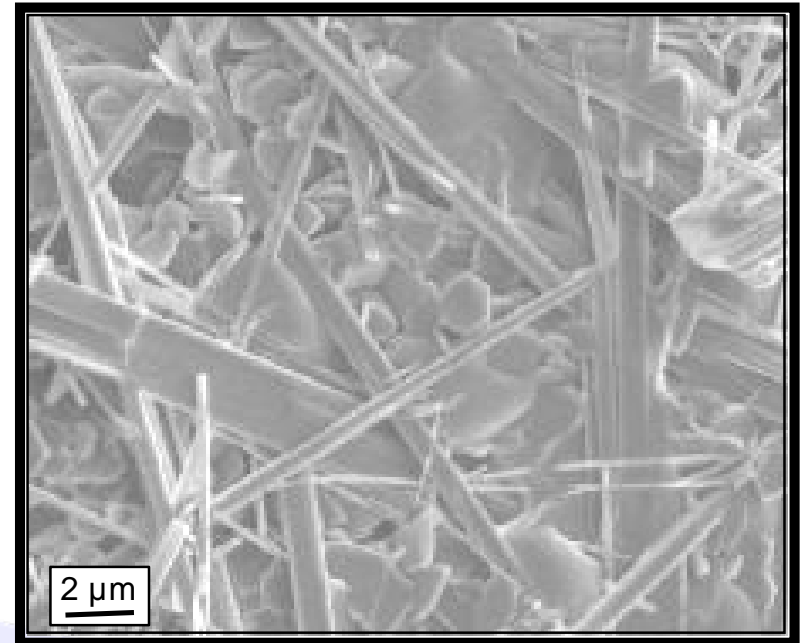


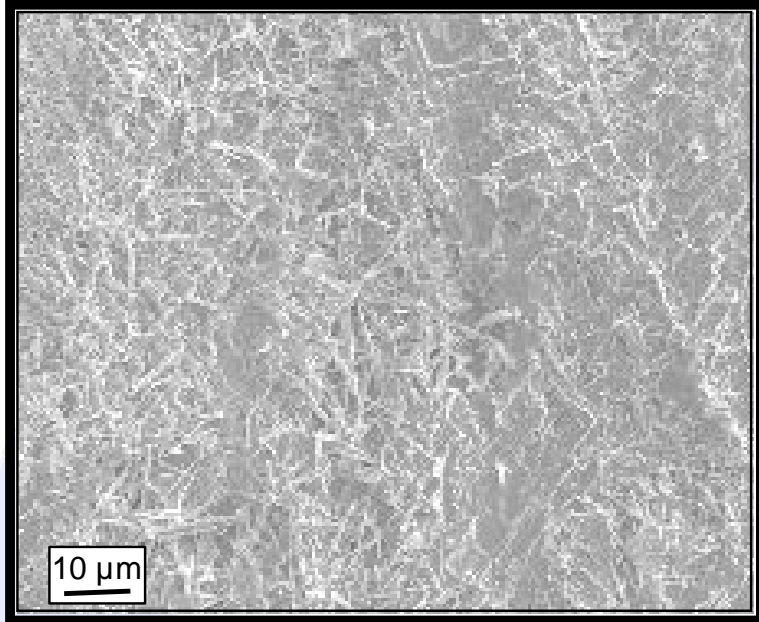


Flux Morphology:

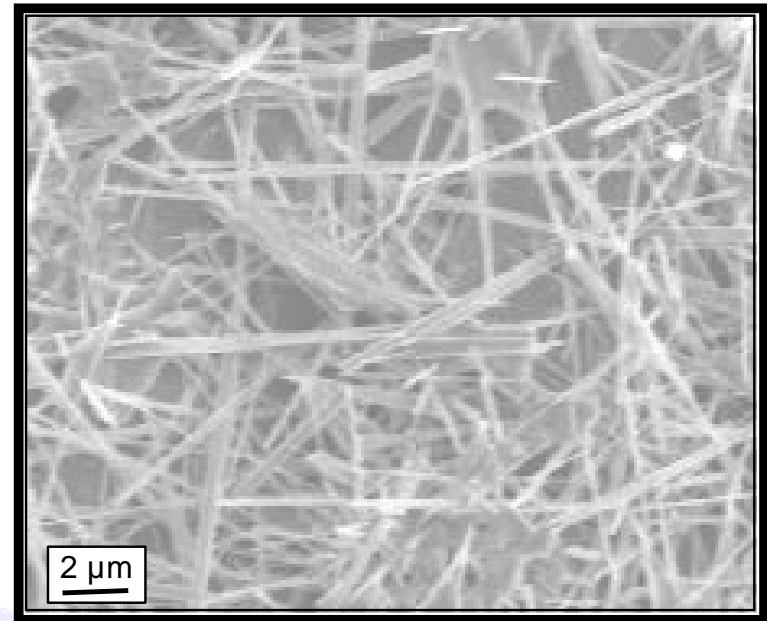


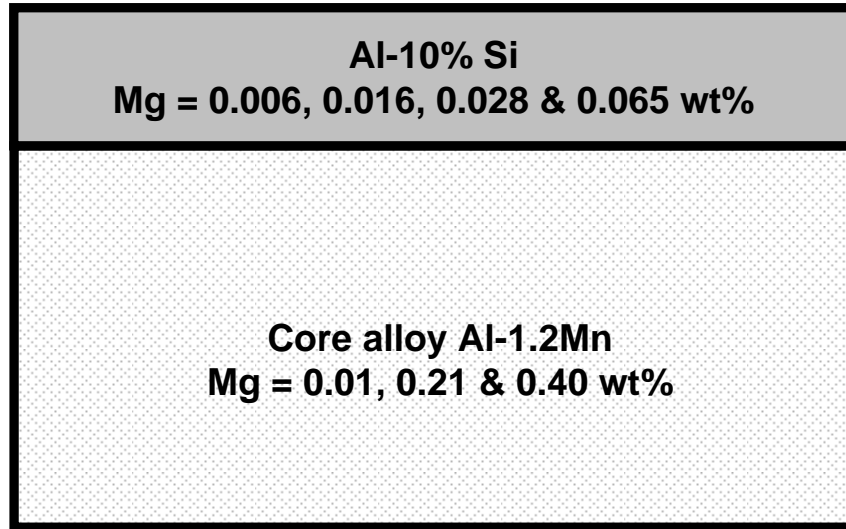
**Clad Surface
0.3 wt % Core**



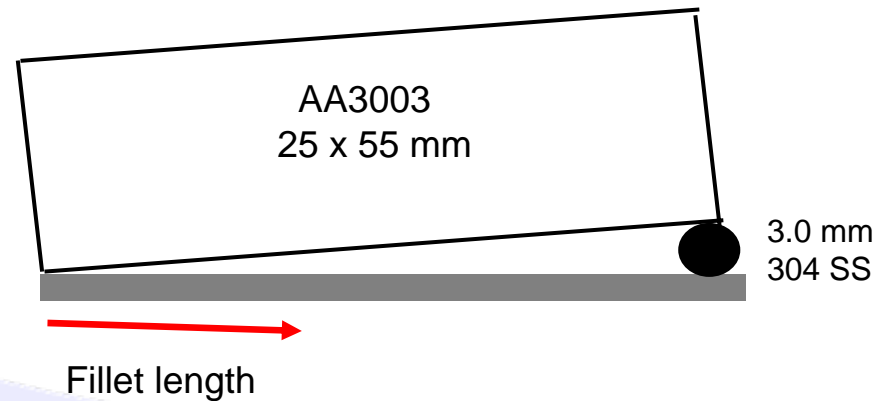


Core Surface
0.3 wt% Mg core





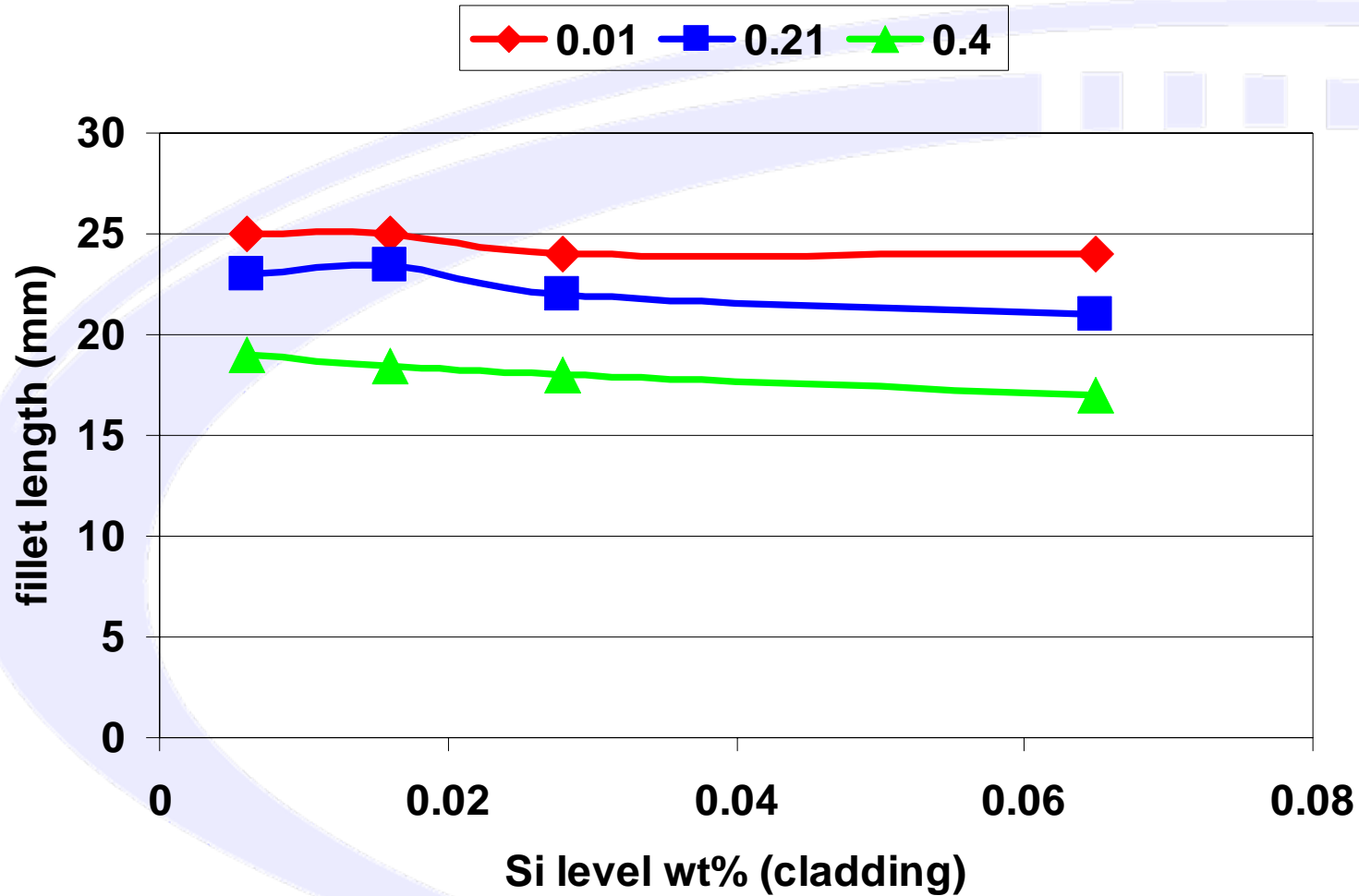
Flux levels:
32 g m⁻²
8 g m⁻²
2 g m⁻²



Hisatomi et al,
Jpn Inst. Light Metals 1998



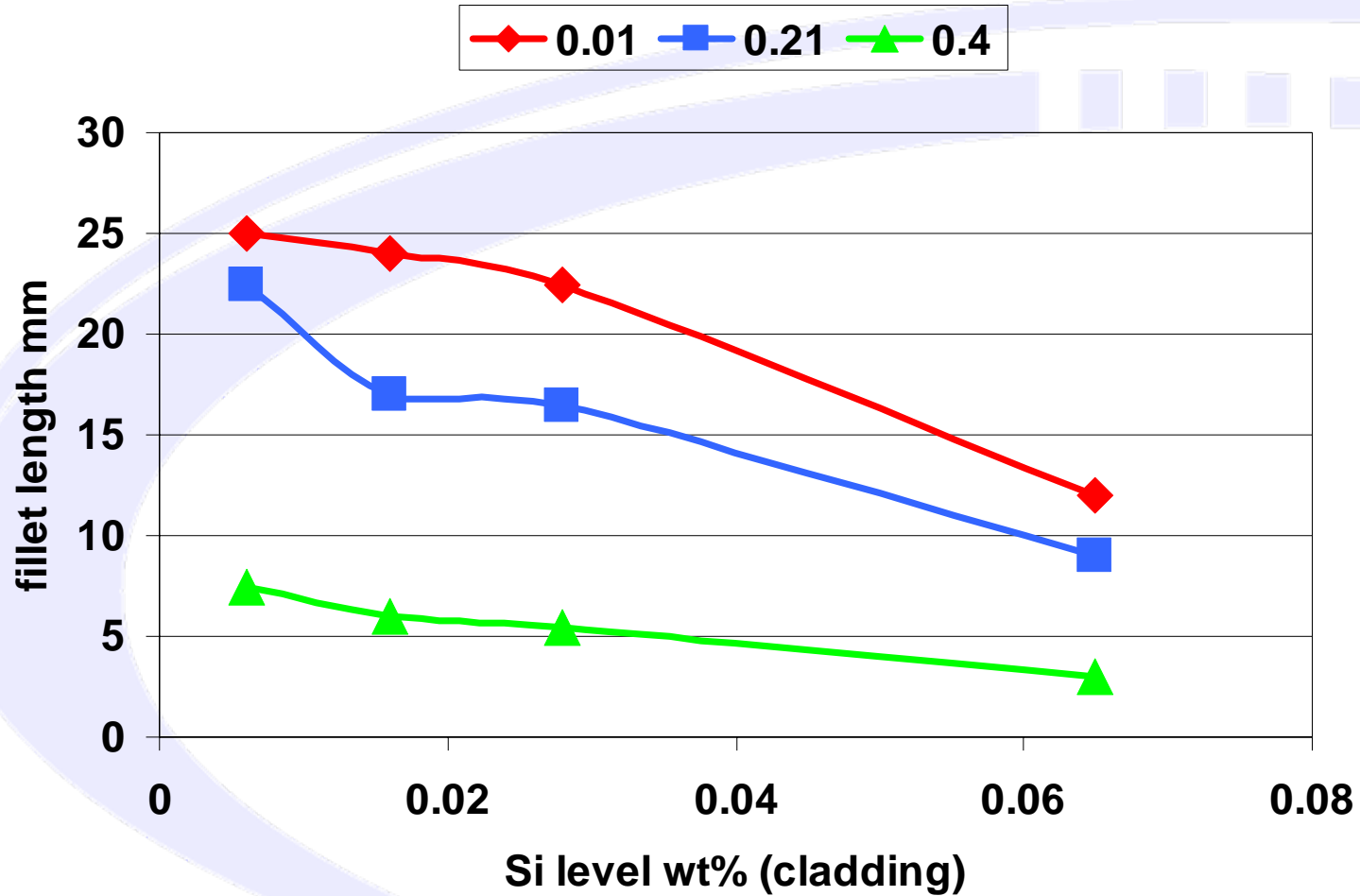
Clad/core Mg Interactions: High Flux



Hisatomi et al,
Jpn Inst. Light Metals 1998



Clad/core Mg Interactions: Low Flux



Hisatomi et al,
Jpn Inst. Light Metals 1998



- Pre-existing oxide (surface) reduces clad fluidity
- Influence of sub-surface oxide?
- Increasing Mg level in Al-Si cladding reduces melting point and extends melting range
- Majority of Mg retained in solid solution in the cladding alloy
- Reducing Mg level in cladding increases tolerance in core
- Increasing clad thickness will increase tolerance to Mg



- Oxidation suppressants in clad alloy
- Mg clad/core interactions
- Clad/core with interlayer
- Mg/Flux interactions
- Removal of surface and sub-surface oxide