

Coatings for Drop-wise Condensation

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Contents

1. Alkemy Coatings
2. Drop-wise Condensation Experiments
 - The University of Birmingham
 - Alkemy Ltd
1. Next Steps
2. Appendix



1. Alkemy Coatings



1. Alkemy Coatings

- In collaboration with a number of European suppliers, at Alkemy Ltd we have developed a range of affordable nano-scale coatings.
 - Details have been included in the appendix.
- For a long time we have understood the very hydrophobic nature of many of our coatings.
 - In collaboration with The University of Birmingham, we started earlier this year to look at the potential benefits of drop-wise condensation using Alkemy coatings.
 - We then constructed our own test rig to test a wider range of coatings under a wider range of conditions.





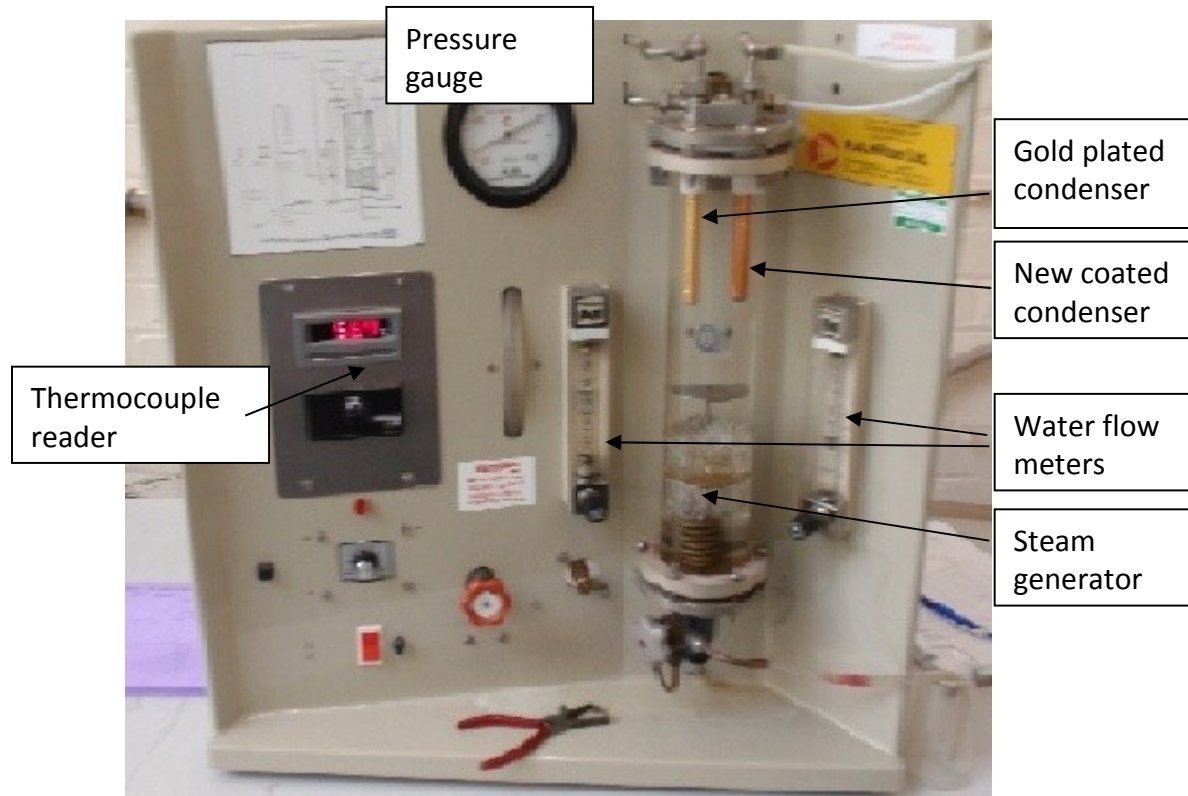


Alkemy Gold Coated Aluminium Plate

2. Drop-wise Condensation Experiments



Birmingham University conducted condensation experiments against a gold-plated test standard.



Dr Raya Al-Dadah
The University of Birmingham



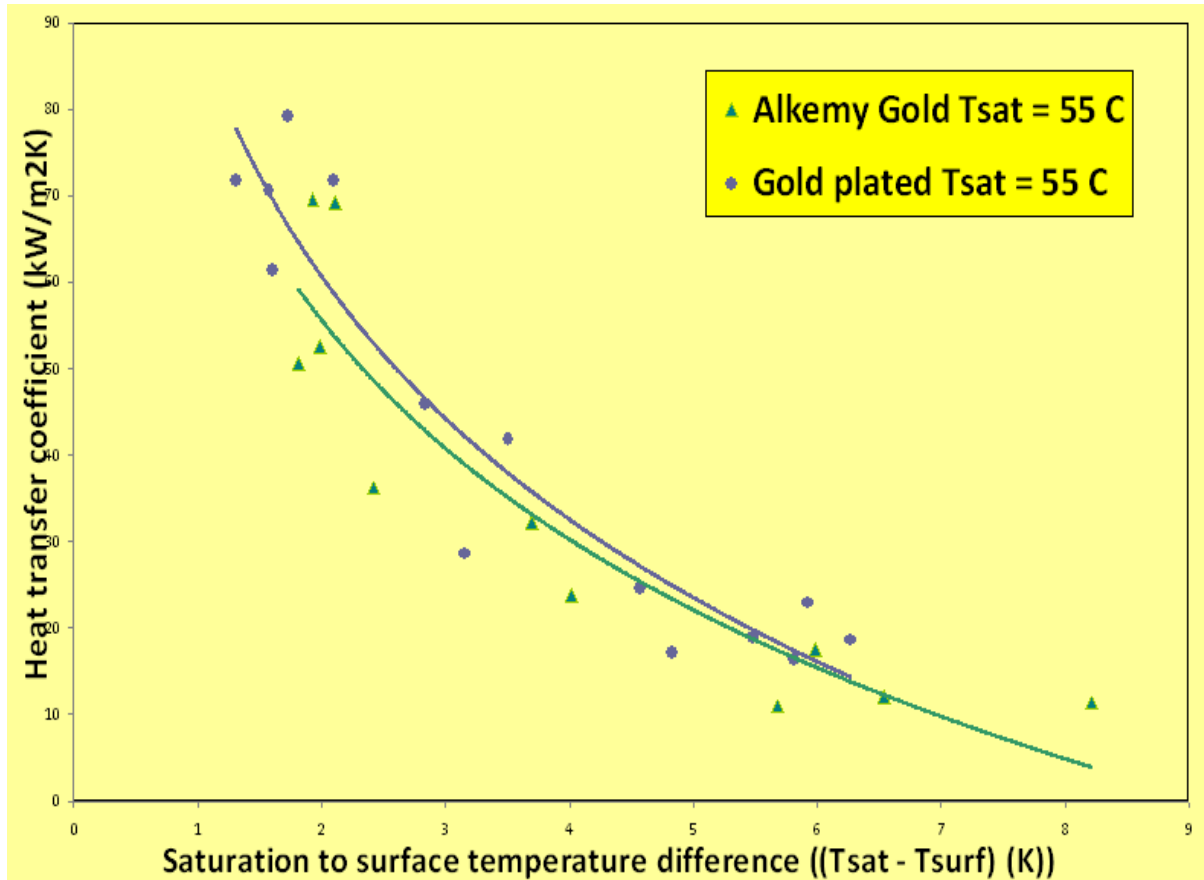
Gold Plated

Alkemy Gold Coated



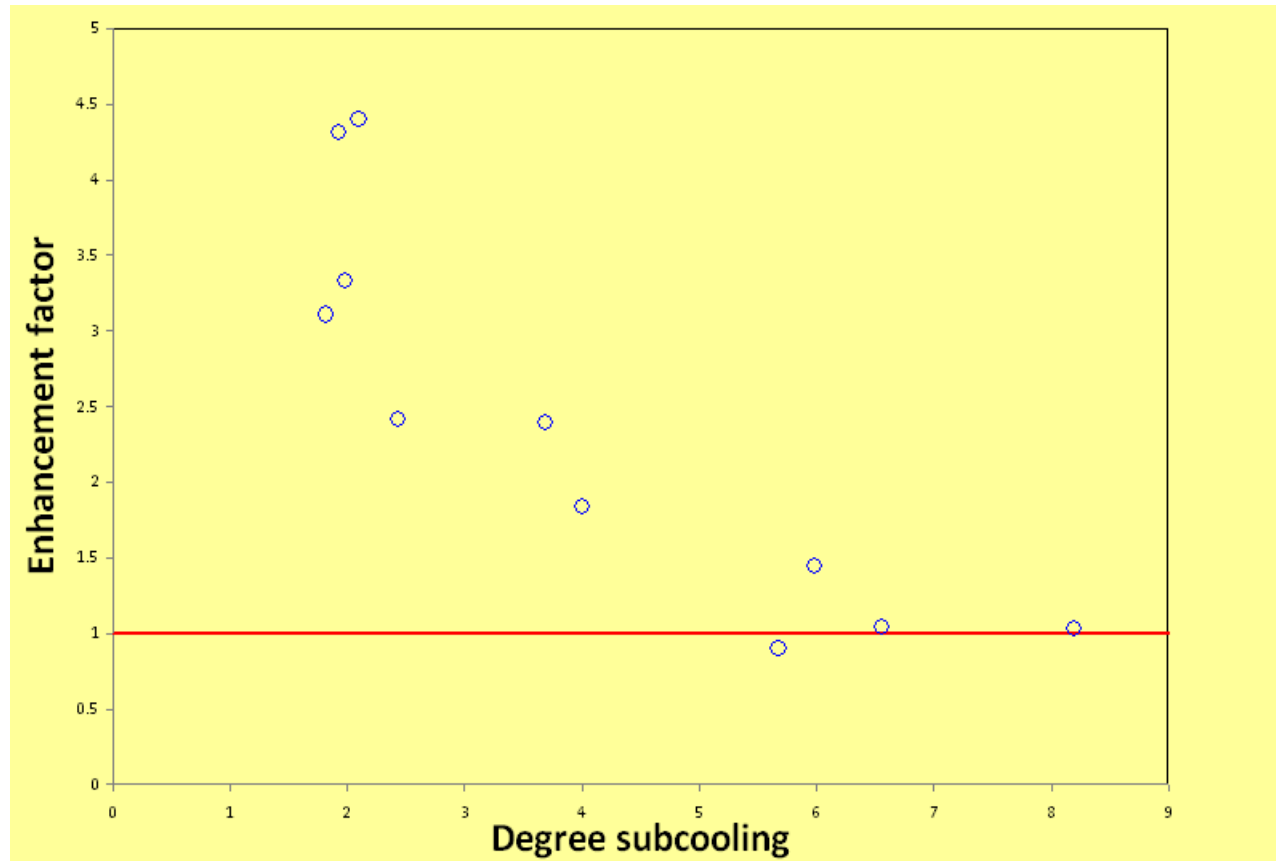
Dr Raya Al-Dadah
The University of Birmingham

Alkemy Gold performed as well as the gold plated condenser.



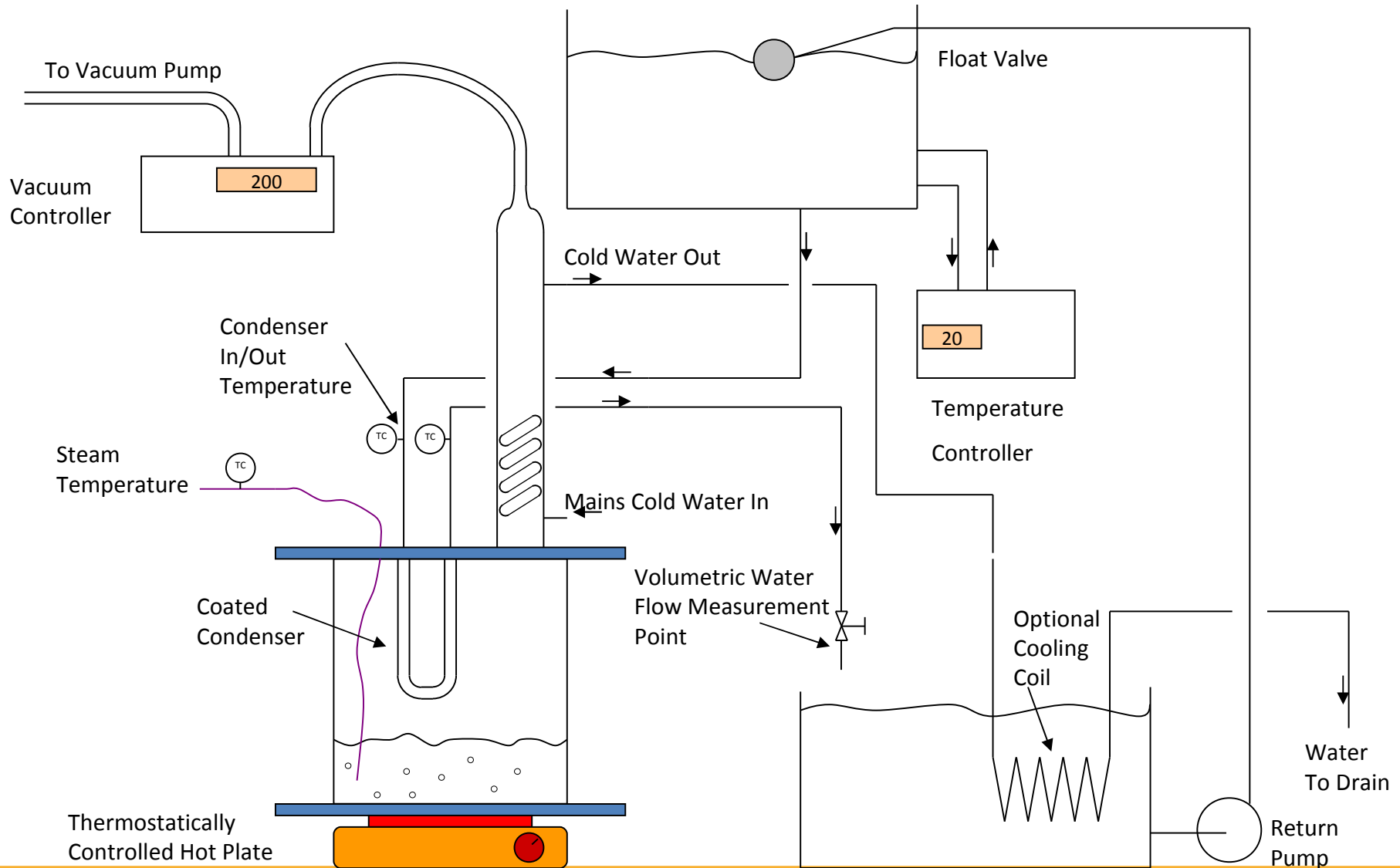
Dr Raya Al-Dadah
The University of Birmingham

Enhancement versus pure copper was better at lower degrees of sub-cooling, rising to a factor of over 4 in enhancement of surface heat transfer coefficient.

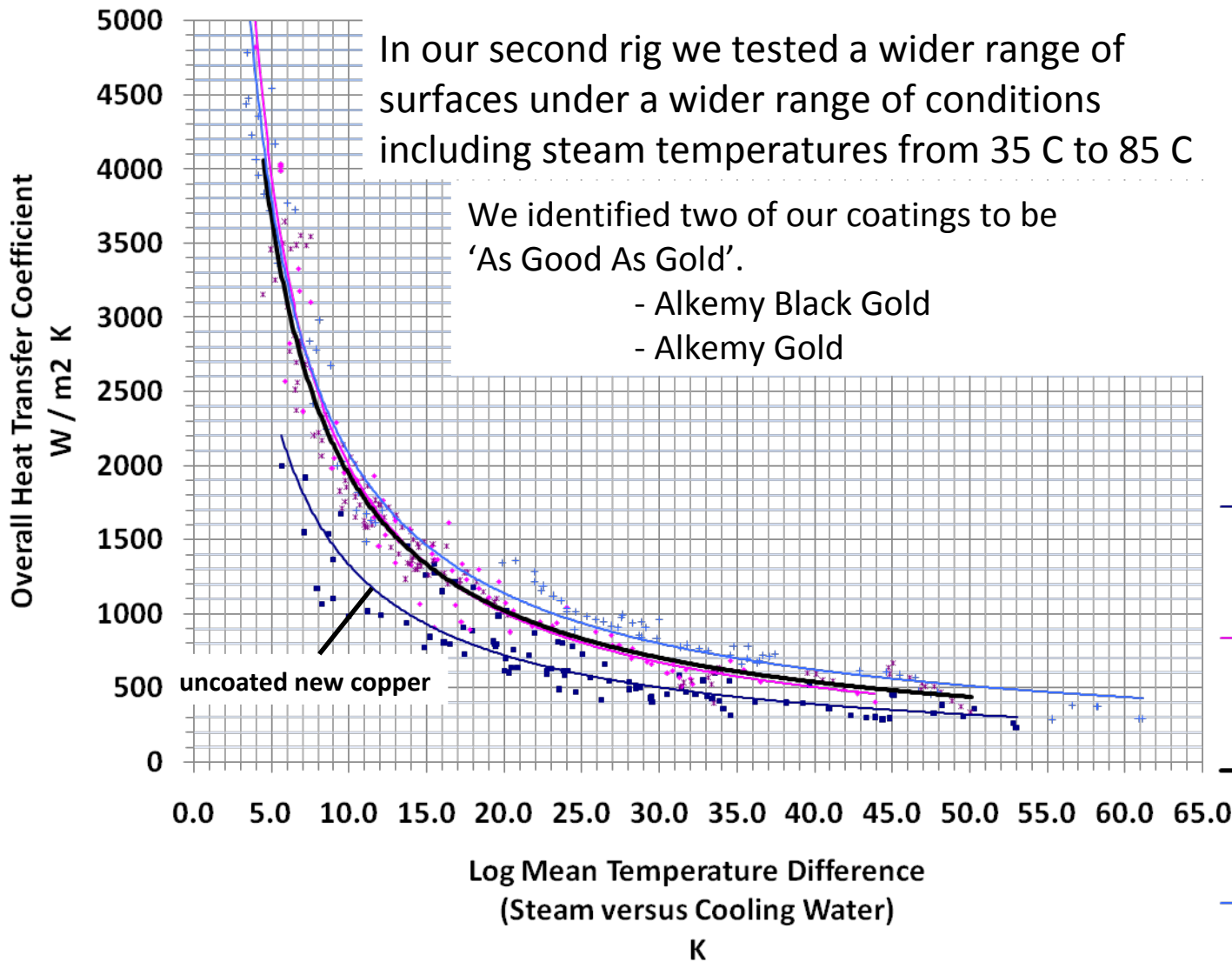


Dr Raya Al-Dadah
The University of Birmingham

Alkemy Ltd Condensation Heat Transfer Rig



Influence of Log Mean Temperature Difference (Steam versus Cooling Water)
on Overall Heat Transfer Coefficients



■ Uncoated New Copper

◆ Gold Plated

× Alkemy Black Gold

+ Alkemy Gold

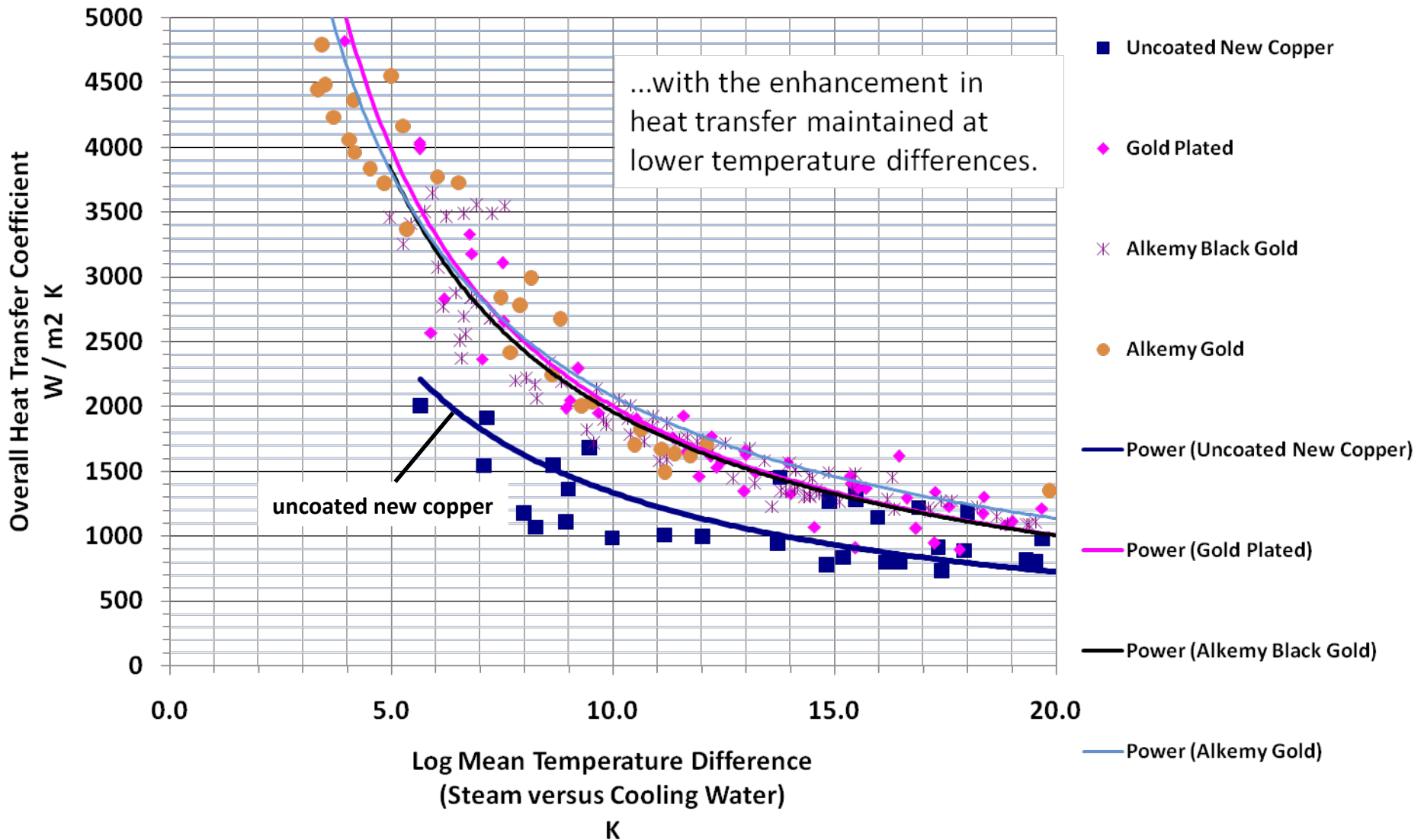
— Power (Uncoated New Copper)

— Power (Gold Plated)

— Power (Alkemy Black Gold)

— Power (Alkemy Gold)

Influence of Log Mean Temperature Difference (Steam versus Cooling Water)
on Overall Heat Transfer Coefficients



Thanks to:

1. The University of Birmingham.

- Prof. Bott
- Dr. Raya al Dadah
- Dr. Ahmed Elsayed

1. Birmingham University Innovation Award.

2. BRDL

3. Next Steps



Next Steps

1. At Alkemy we want to:
 - Continue our collaboration with The University of Birmingham.
 - Reach out to industrial collaborators to develop applications in drop-wise heat transfer for our coatings.

1. We found some surprising results for all surfaces.
 - Condensation heat transfer is limited by the surface renewal of the condensed water and is not affected by the degree of sub-cooling.
 - Whilst this is not a priority for us, we wish to explore this finding / hypothesis from a more academic perspective to enhance our understanding of the benefits of Alkemy coatings for condensation heat transfer.

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4. Appendix

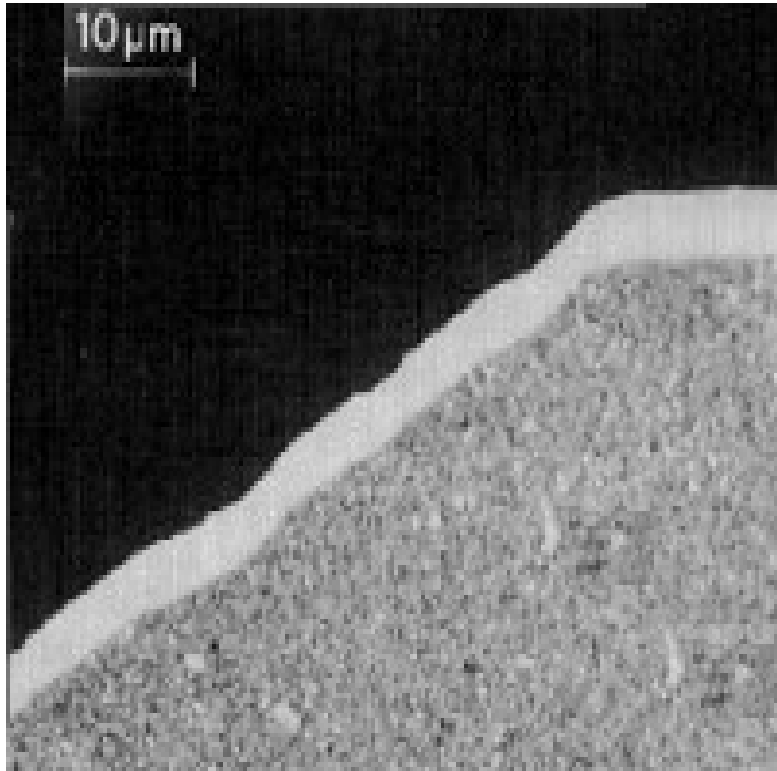


Alkemy Coatings

- In collaboration with a number of European suppliers, Alkemy Ltd has developed a range of affordable nano-scale coatings.
 - Thin (typically 10 microns).
 - Completely dense.
 - Silicate bonds with metals that tend to oxidize or tarnish such as Aluminium.
 - Retain a large degree of elasticity.
 - Thermal expansion coefficients similar to metal.
 - Formulated to be hydrophilic or hydrophobic.
 - Can include actively anti-microbial ingredients to produce coatings that actively kill e-coli and MRSA, for example.
 - Very smooth surfaces to the point of being anti-fingerprint.
 - Provide a complete barrier that prevents corrosion such as saltwater on Aluminium or sulphides on Silver.



Alkemy Coatings

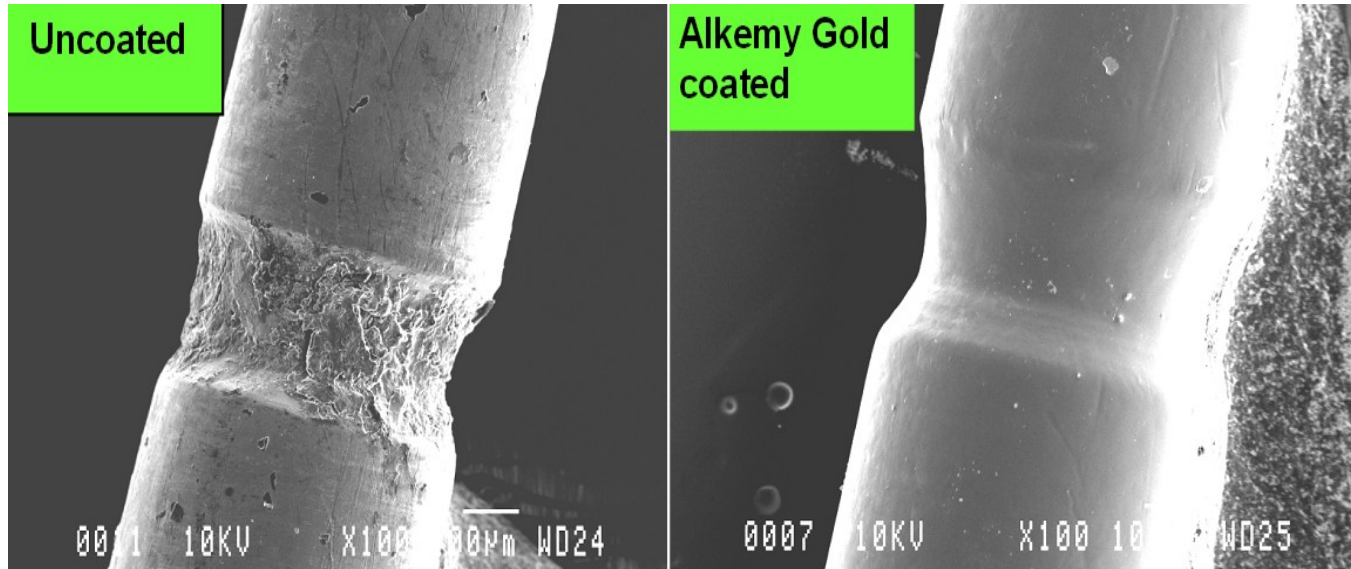


Coating

Metal



Alkemy Coatings

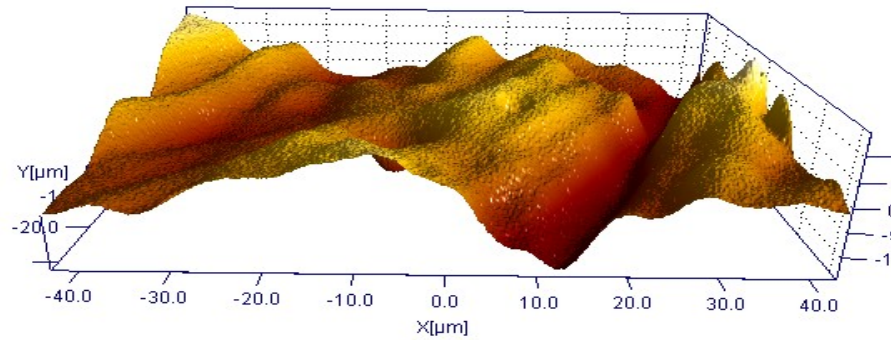
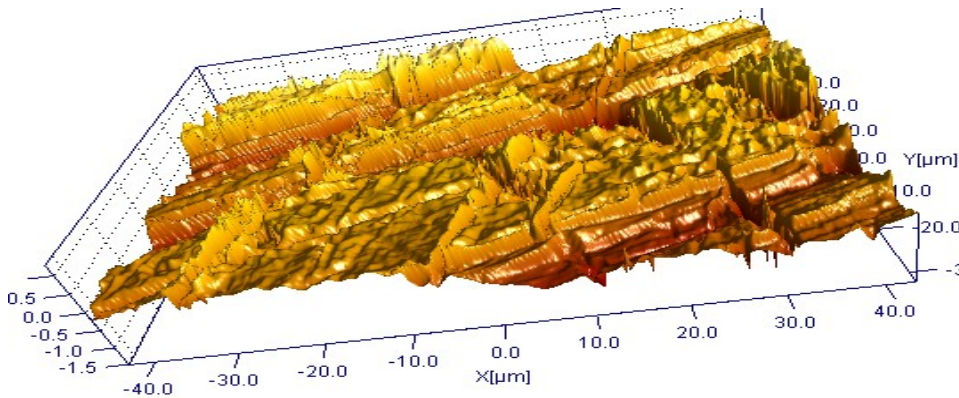


Alkemy Gold modifies surface topography

Smooth, low friction surface inhibits deposition of organic & inorganic material



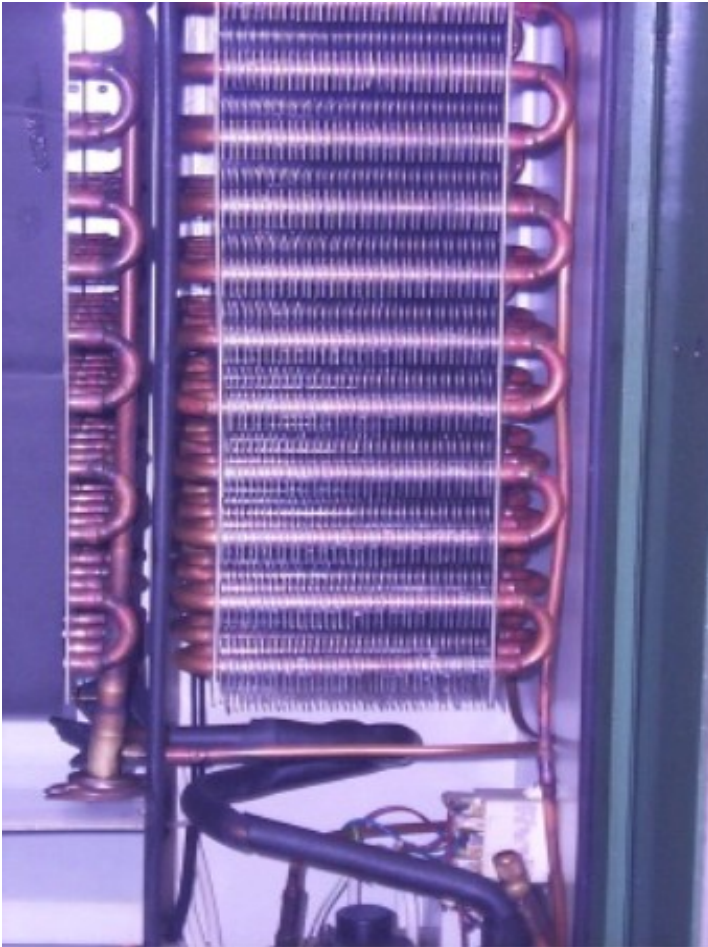
Alkemy Coatings



Electron microscopy for uncoated and coated copper surfaces.



Alkemy Coatings

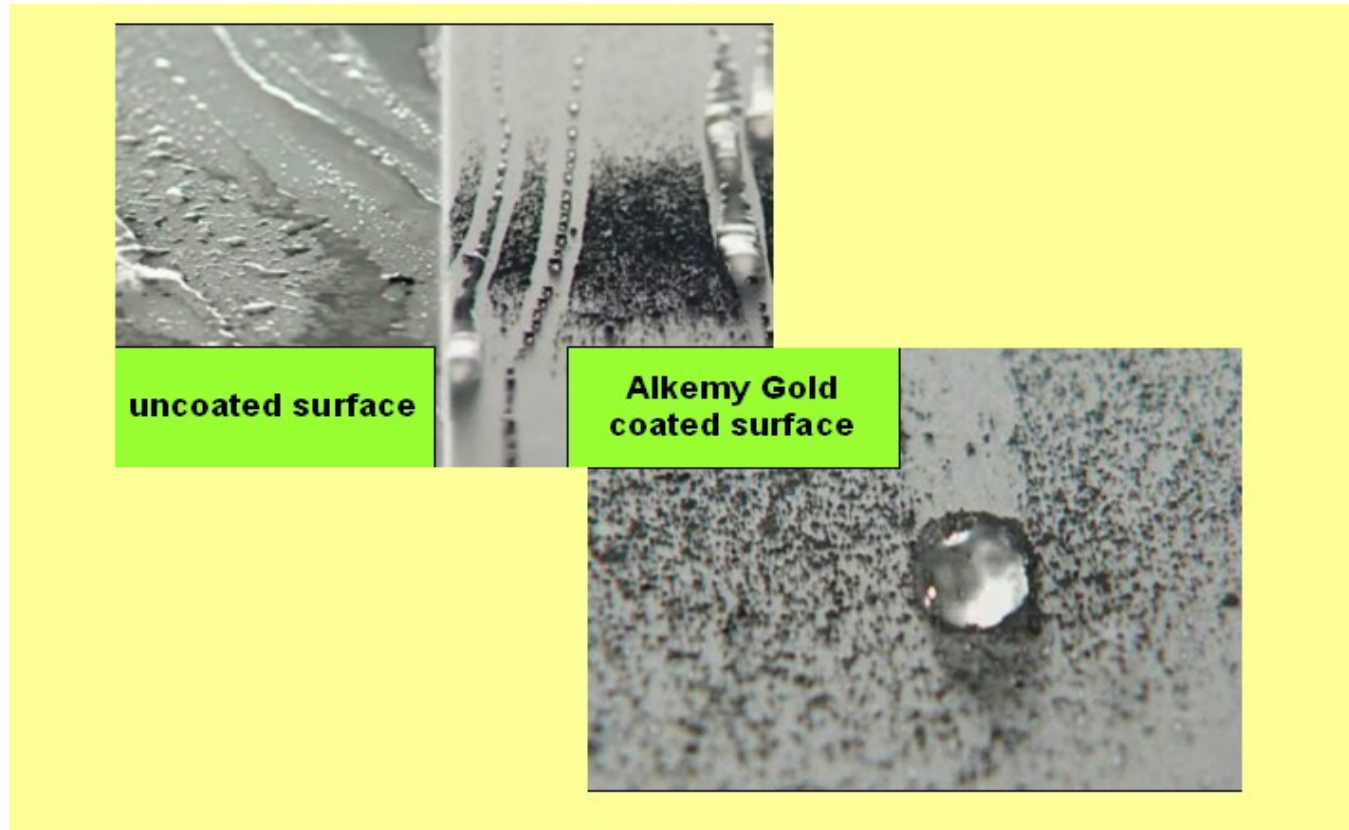


**Coated Heat Exchanger made of aluminium
after 18 month exposure without filter;**

- **No Corrosion**
- **No Dirt Adherence**
- **No Blockage of Lamellae.**



Alkemy Coatings



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