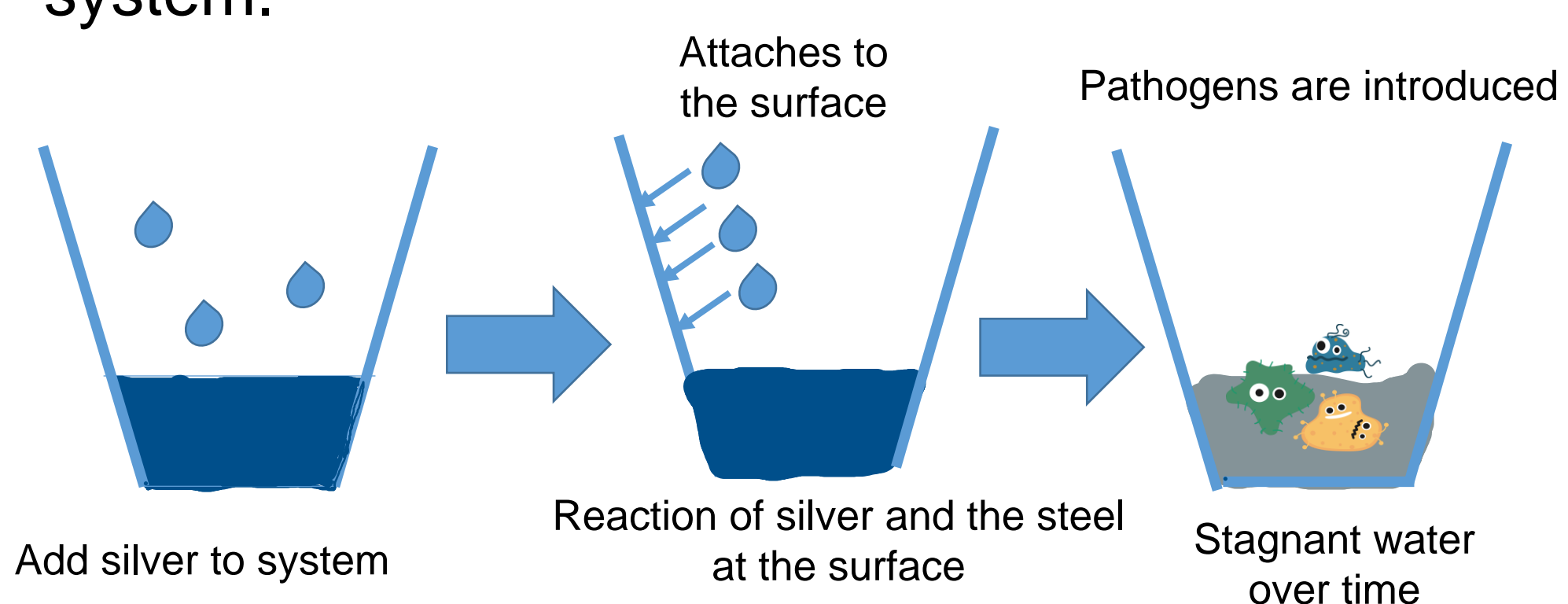


The Analysis of Silver Depletion on Stainless Steel for Potable Water System

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Introduction

- The integrity of water systems on spacecrafts are integral for the safety of the crew so studying depletion of silver from the steel material prevents:
 - Pathogens from entering a system
 - Biofouling over time
 - Stagnant water from affecting performance of the system
 - Operational costs from increasing
- The silver reacts with the stainless-steel material from the tank and tubing of the water storage system.



Research question and objectives

Research question: What type of coating on stainless steel can be used to best decrease or prevent the depletion of silver?

Objectives:

- Treating stainless steel with different chemistries and studying ceramic coatings.
- Using a surface to volume ratio of 2, find the volume of AgF for each coupon.
- Understand scanning electron microscopy (SEM) to look at the morphology of the surfaces.

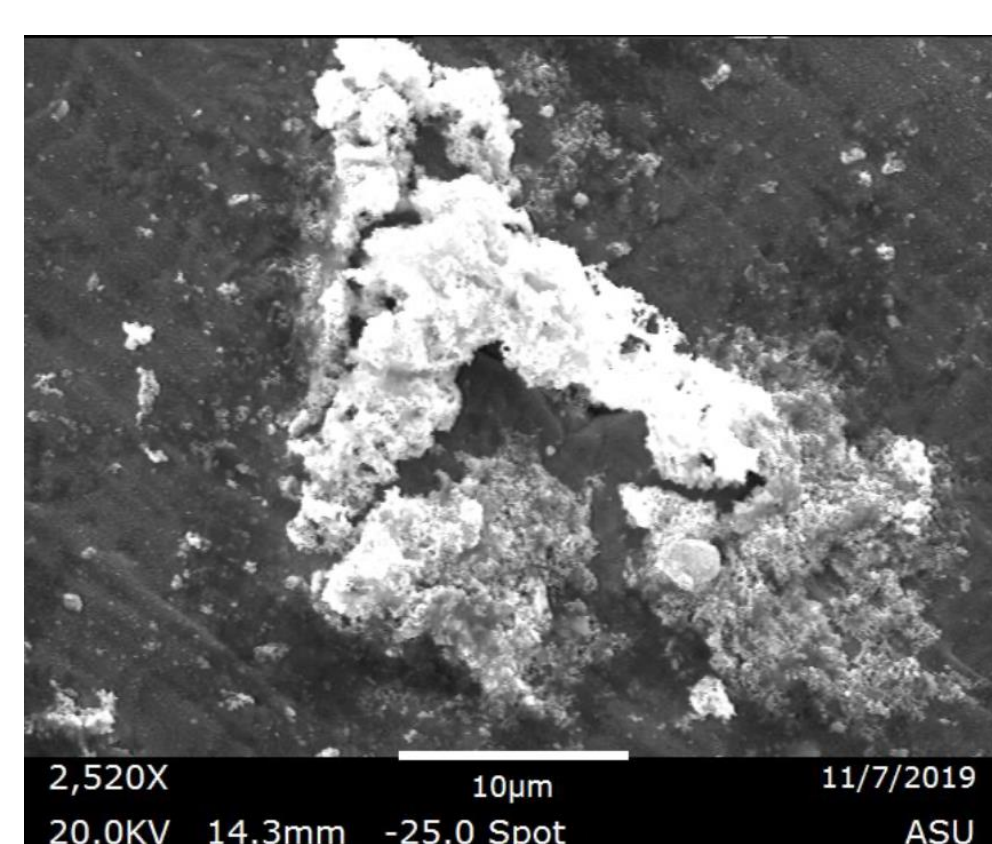
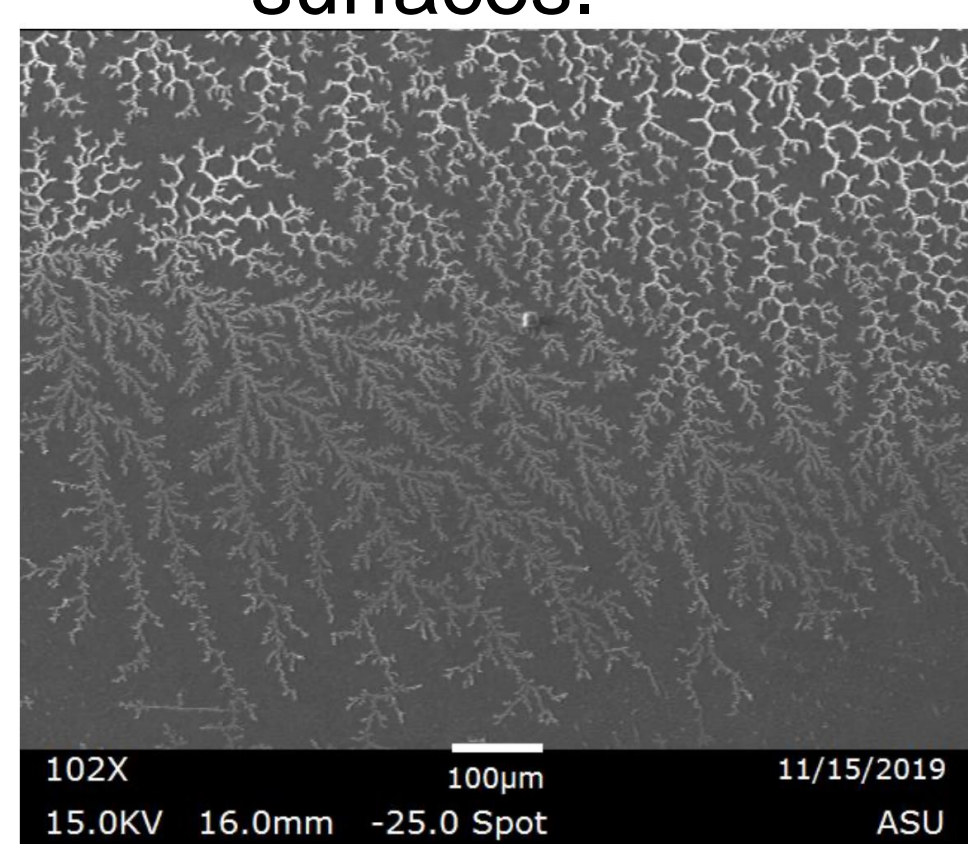


Figure 2: NBH₄ and 10⁻¹ M Na₂S coated on steel 444 pattern

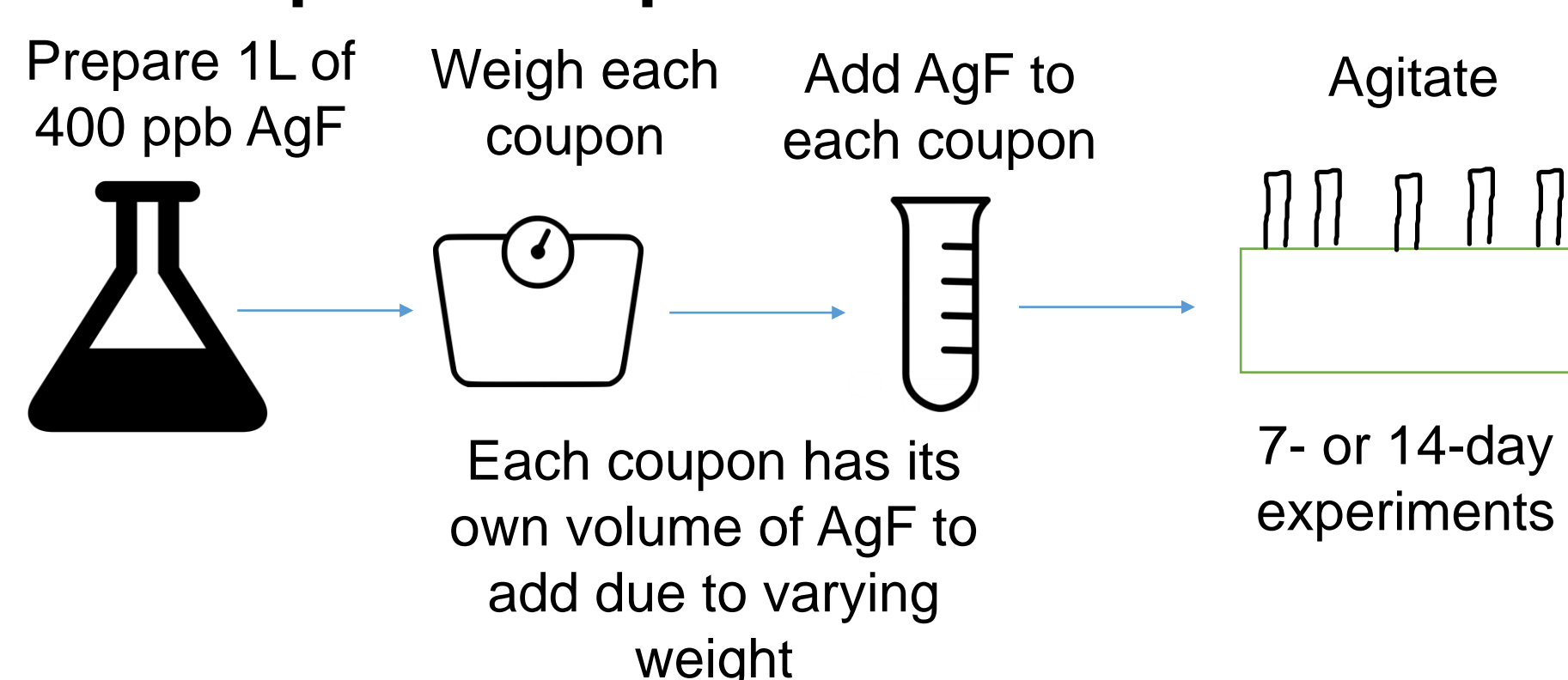
Figure 3: AgNPs agglomerating on 10⁻¹ M Na₂S SS

Methodology

Coating of Steel coupons:

- Cut the alumina sheets using a diamond cutter into coupon sizes. Cut the stainless-steel coupons.
- Weigh the coupons in triplicate groups and pick out 15mL test tubes and 50 mL test tubes for weights of ≤ .55 g and ≥ .55g respectively.
- Wash steel coupons in ethanol solution and agitate for 20 minutes. Rinse with DI water.
- Keeping the same surface area to volume ratio, compute the amount of volume needed to add to the test tubes based on the coupon weight, and cover coupons.

Silver Depletion Experiment



Methodology



Figure 5: stainless steel coupon washed in ethanol, 300 mM AgNO₃, and 300mM NaBH₄.

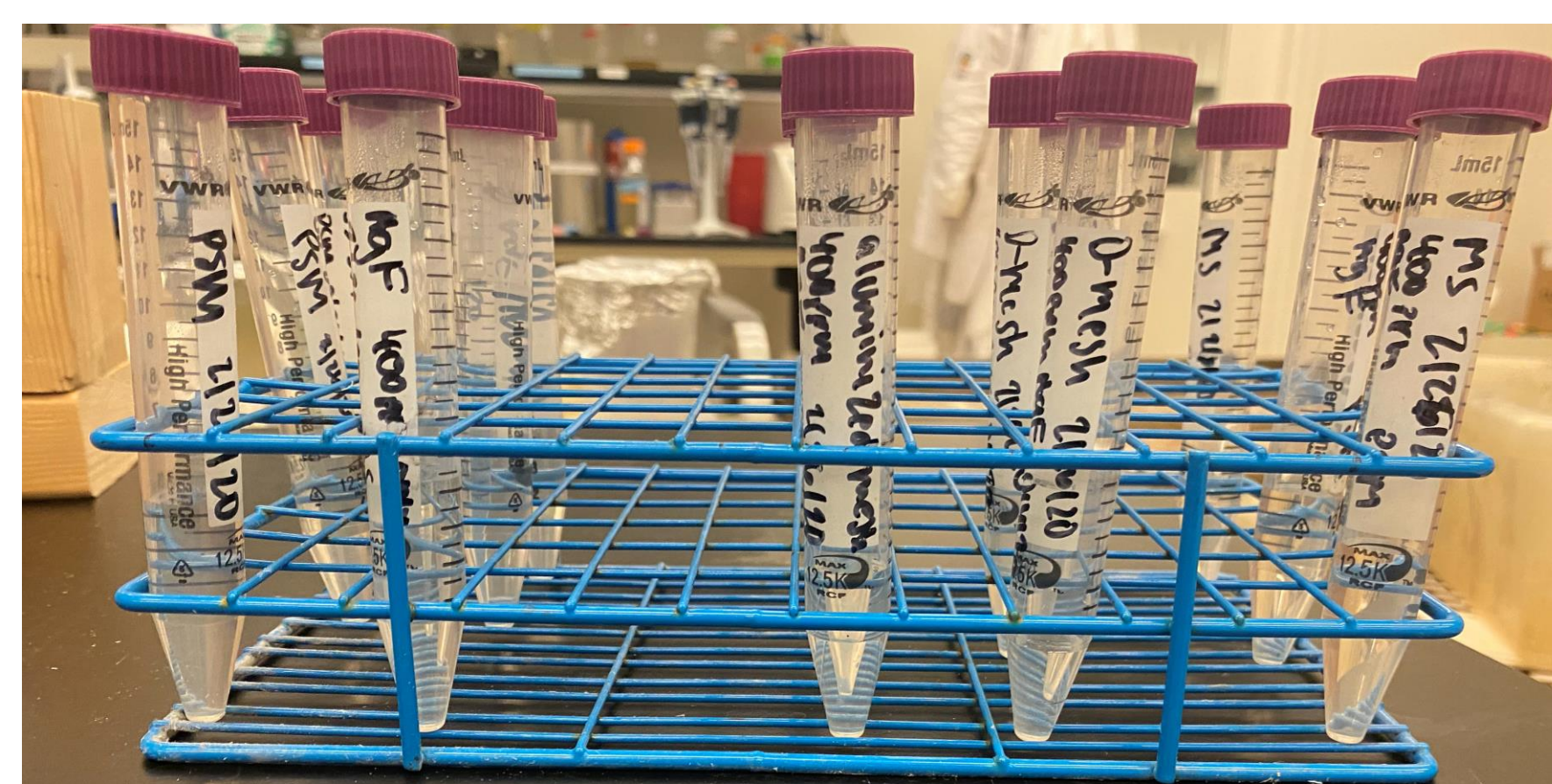


Figure 5: coupons in AgF solution to be agitated for 7 days

Obstacles Overcome

Obstacles to Tackle:

- Without a pre-determined best fit coating for the stainless-steel coupons, looking at thicknesses of the alumina sheets on the SS can be indicators
- Analysis had varying results compared to previous work completed
- The process for coating alumina on SS is lengthy

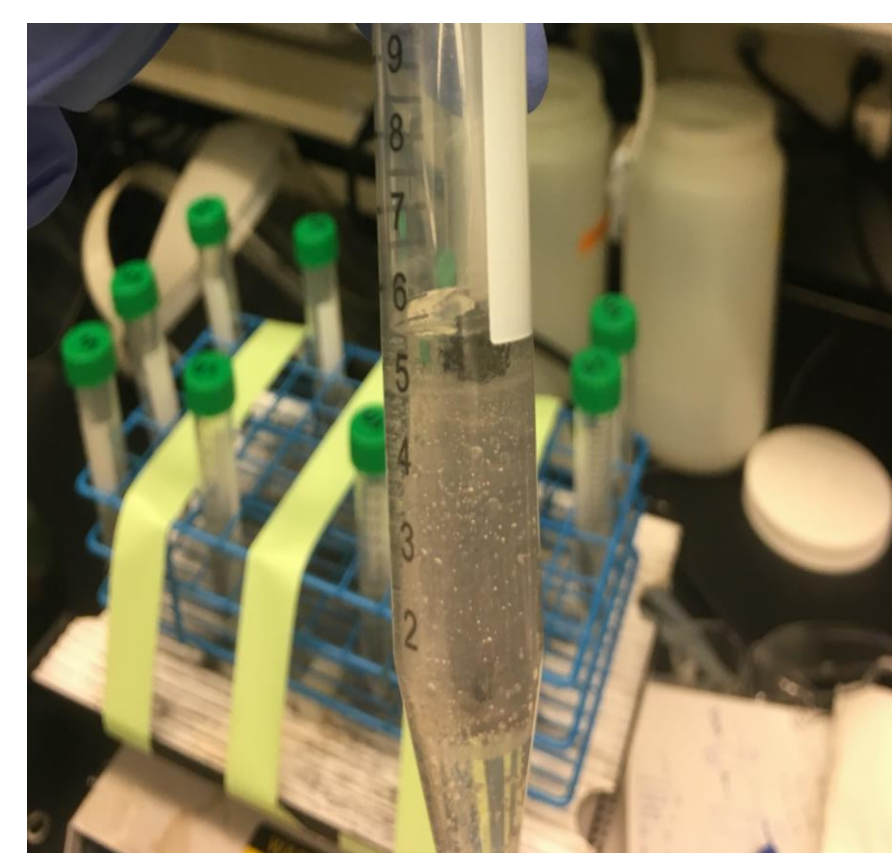
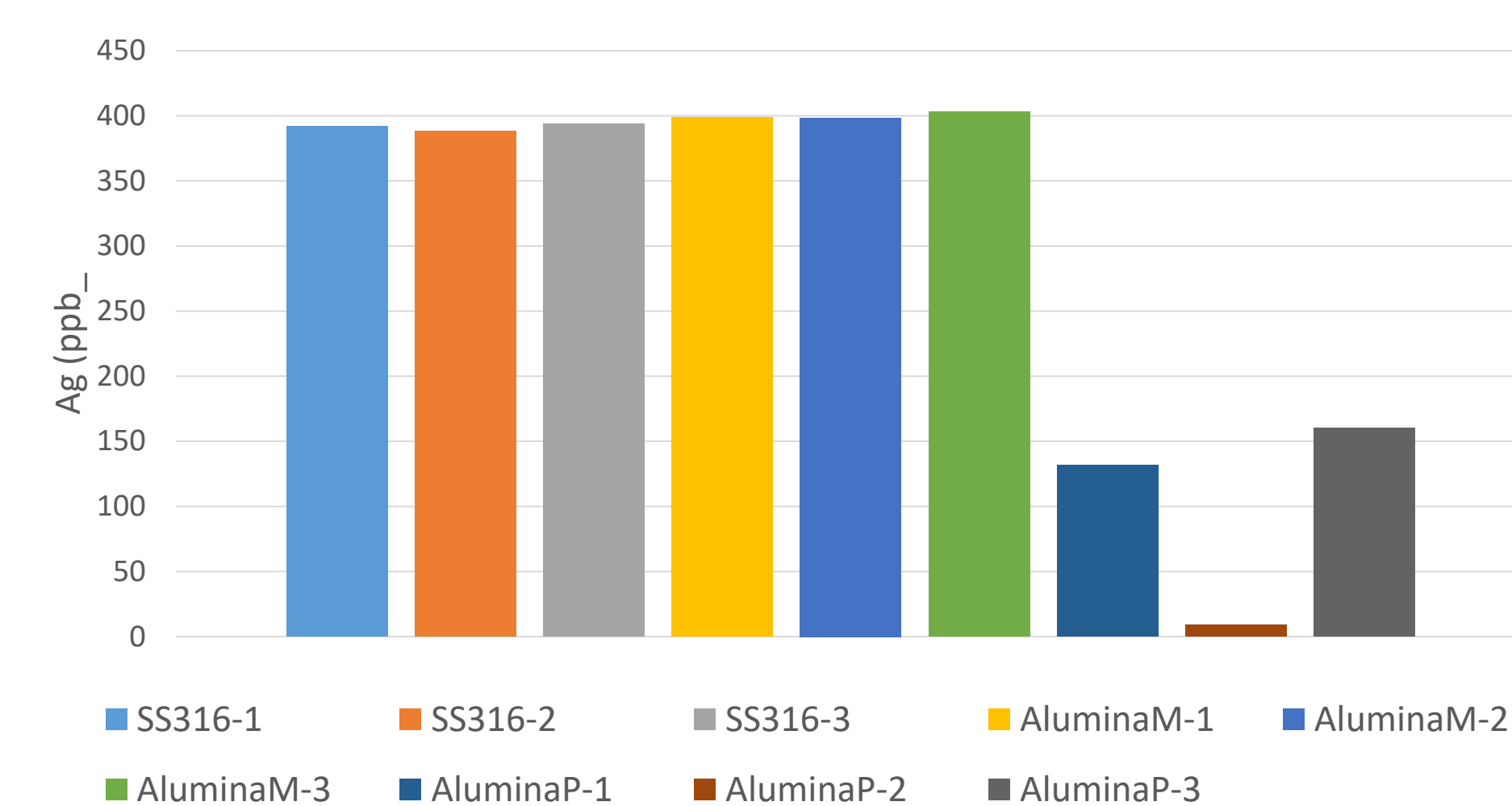


Figure 6: Close up of silver and NBH cluster from mixing after coating coupons

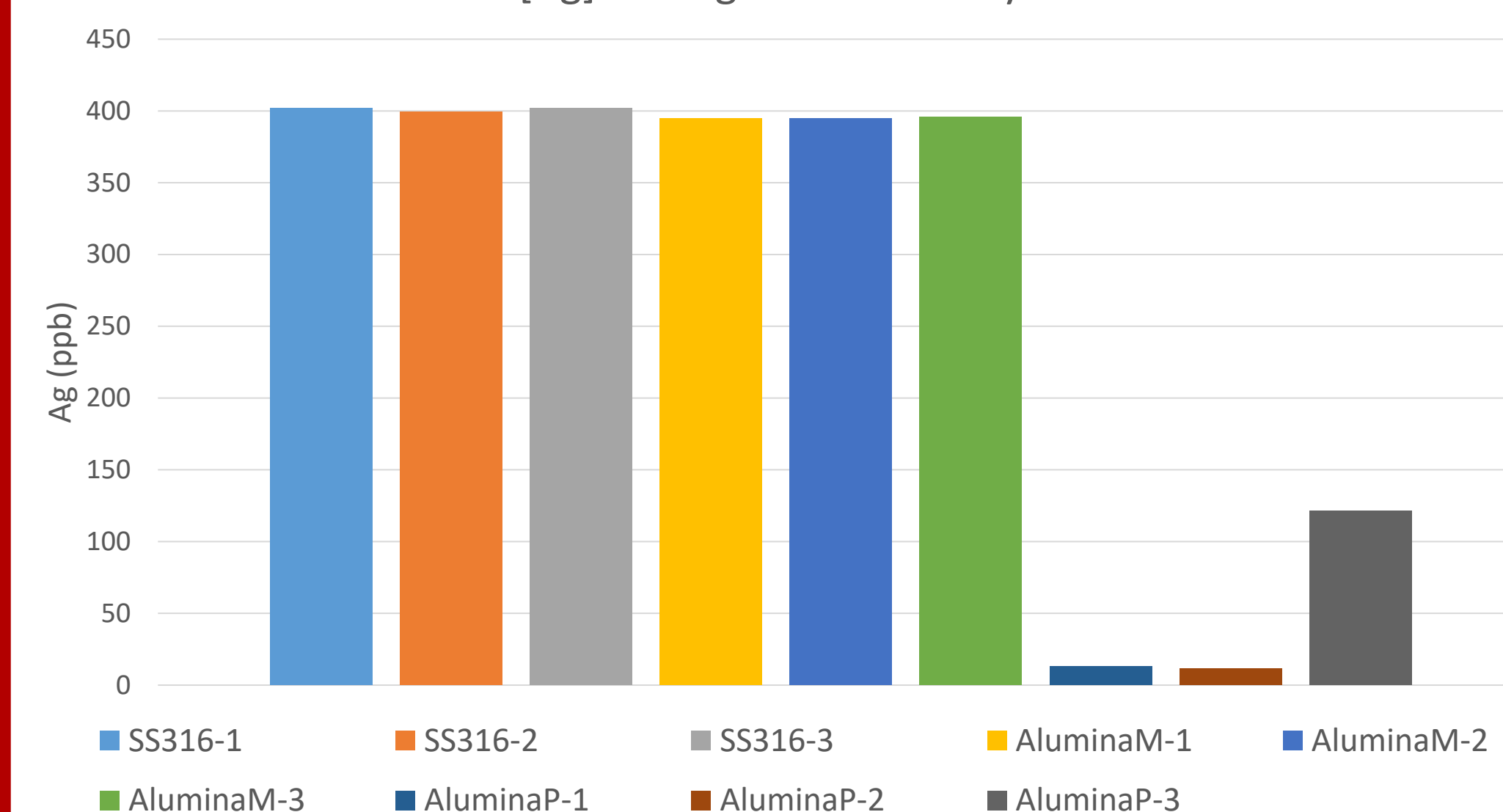
Results & Findings

[Ag] Averages after 7 days



- AluminaP samples show significant amounts of loss of silver
- SS316, even though not treated show little loss of silver compared to previous work conducted
- For AluminaM samples, little to no silver sticks onto the coupon surface

[Ag] Averages After 14 days



- At 14 days, there are similar results to the 7-day averages
- AluminaP samples again show significant amounts of loss of silver
- AluminaM samples show almost no loss of silver after agitation

Conclusions

- More testing needs to be done to see if ceramics are viable materials to coat stainless steel with, specifically for alumina oxide sheets.
- To optimize the coating, understanding which thickness is best to coat the steel needs to be determined.
- Other ceramics and thicknesses should be experimented

Future Work

- In the Perreault lab, further research will be done on pre-coating the steel as well as using other materials and chemistries to see what is best fit for dealing with silver depletion for potable water systems in space crafts.

References

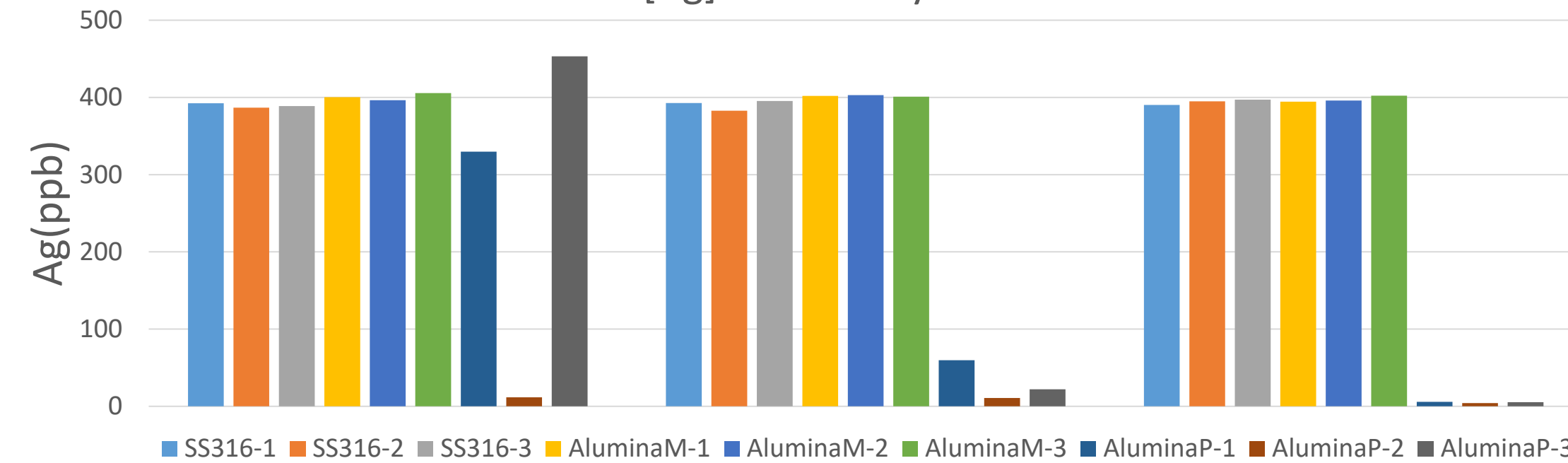
1) Maria Petala et al. 2016. Silver Deposition, ICES-2016-445.

Acknowledgements

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Results

[Ag] After 7 days



[Ag] After 14 days

