Copper oxide is approved globally as antifouling agent, and provides an effective mechanism for fouling free surfaces. However, the effect of different sizes of cuprous oxide particles on the drag performance of antifouling coatings, and hence on ship hull drag, has not been systematically studied. For the objectives of this PhD research, pressure drop measurements and boundary layer tests were conducted to evaluate the drag characteristics of the surfaces coated with different size cuprous oxide particles under internal and external flow conditions. The surface roughness characteristics were analysed by Scanning Electron Microscopy (SEM) and an optical roughness profilometer to assess the detailed roughness statistics of the surfaces. Based on the analysis results of the roughness and frictional drag measurements, a correlation between the relevant roughness parameters and drag of the tested surfaces was established, and provided insight into how frictional drag (for external flows) or pressure drop (for internal flows) relates to the particular roughness topography.

**Methodology**

- Varied sizes of cuprous oxide particles (D_{50} ranging from 2µm to 250 µm).
- All cuprous oxide particles were applied on standard UNEW test panels (600 x 210mm, L x B, resp.) using a minimal quantity of binder and air-assisted spray.
- Boundary layer measurements were completed by using two-dimensional Laser Doppler Velocimetry (LDV) system in the UNEW Emerson Cavitation Tunnel (Figure 2).
- Pressure drop measurements were completed by using turbulent flow channel (with the test section of 10 x 180 x 2700 mm in H x W x L, resp.) (Figure 3).
- Close images and roughness measurements were collected by using Scanning Electron Microscope (Figure 4-A) and Optical Surface Profilometer (Figure 4-B and 4-C), respectively.

**Results and Discussion**

**SEM scanning (surface microstructure)**
- According to Figure 5, the smallest sized particles (D_{50} = 2µm) are more easily stick together (due to aggregation/agglomeration) than do larger sized particles.
- The aggregation/agglomeration of D_{50} = 2µm particles resulted in rougher surface characteristics.
- Lower and smoother microstructure profiles were formed by D_{50} = 7µm, 12µm and 17µm particles, with fewer interspaces remaining compared to the larger sized particle surfaces (i.e. D_{50} = 60µm, 100µm and 250µm).
- Compared with larger particles, small sized particles have a higher possibility to fill gaps and make the surface smoother,

**SFM scanning (roughness measurements)**
- According to Figure 6, the smallest sized particles (D_{50} = 2µm) gave the smallest roughness values.
- The aggregation/agglomeration of D_{50} = 2µm particles resulted in rougher surface characteristics.
- The larger sized particles (D_{50} ≥ 7µm) gave the highest roughness values after the local pressure drop tests, whereas the pressure drop tests give frictional drag caused by the overall surface condition. Therefore, a rough and uneven surface profile, the results can vary due to different testing scale.

**Conclusions**
- Using pressure drop measurements frictional drag of an entire surface can be accurately obtained, by contrast, the LDV tests give a precise description of frictional drag characteristics of a local position.
- The smallest particle sizes (D_{50} < 2um) give anomalous results which can be related to the particle aggregation as well as difficulties during the application process;
- Based on the investigations so far, the lowest surface roughness and frictional force values were given by particle size D_{50} = 12 and 17 µm.
- For those above D_{50} = 60µm there is a remarkable increase in surface roughness and frictional force.