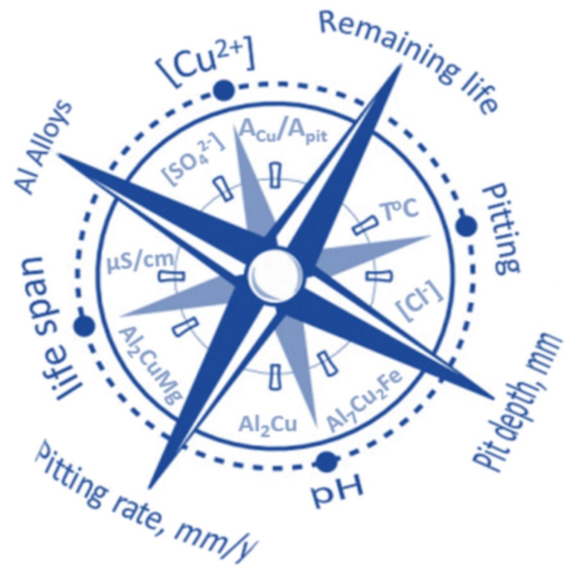

CIPAL-Compass®: Copper-Induced Pitting in Aluminium Alloys - Modeling, Life Prediction and Process Control

Version 9.20

☆ **Performance** ☆ **Functionality** ☆ **Usability**

Anytime Anywhere Any Device Any OS No USB dongles No installation No Browser Plug-ins

Contact Us for A Free Trial Login to Free Trial

Why WebCorr | Performance Guarantee | Unparalleled Functionality | Unmatched Usability | Any Device Any OS | Free Training & Support | CorrCompass

Features and Component of CIPAL-Compass

CIPAL-Compass is the only device and OS independent software on the market for the modeling and life prediction of copper-induced pitting in aluminium alloys used in the microelectronics and semiconductor industry, the chemical process industry, the power generation industry, the water treatment industry, and any industry/sector where aluminium alloys come into contact with waters or process fluids that contain trace amount of copper ions. Designers, engineers, architects, consultants, maintenance and inspection personnel can quickly assess and quantify the impact of copper ions on the pitting corrosion of aluminum alloys, the pit depth, the pitting rate, the remaining life of their components or systems, and the critical level of copper ions for process control. CIPAL-Compass utilizes machine learning and cloud computing and works anytime, anywhere, on any device running any OS without the need to install or download anything.

CIPAL-Compass consists of two modules:

- Copper-Induced Pitting in Aluminium Alloys module is used for modeling and life prediction of aluminum alloys in contact with trace amount of copper ions in waters and process fluids.
- Intermetallics module is used for modeling and life prediction of intermetallics-induced pitting in aluminium alloys.

Overview and Application Examples of CIPAL-Compass for Modeling and Life Prediction of Aluminum Alloys

Figures below show the screen shots of CIPAL-Compass. CIPAL-Compass quantitatively determines the effect of the chemistry of water or process fluid on the pitting corrosion of aluminum alloys: temperature, pH, conductivity, sulphate, chloride, and copper ions. The outputs from CIPAL-Compass includes the pit depth, the pitting rate, the predicted life span, and the remaining life of the component.

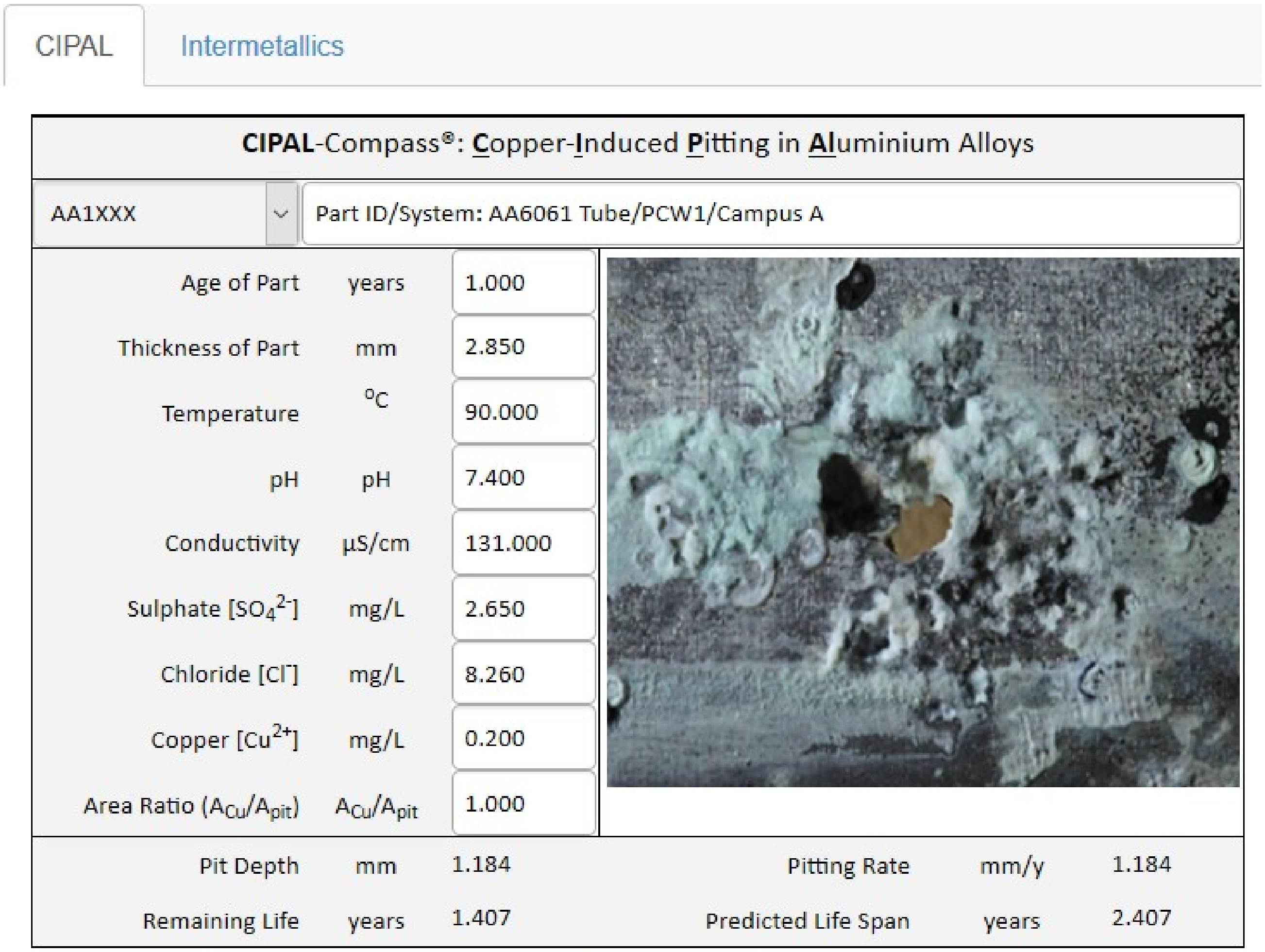

Figure 1 Overview of CIPAL-Compass

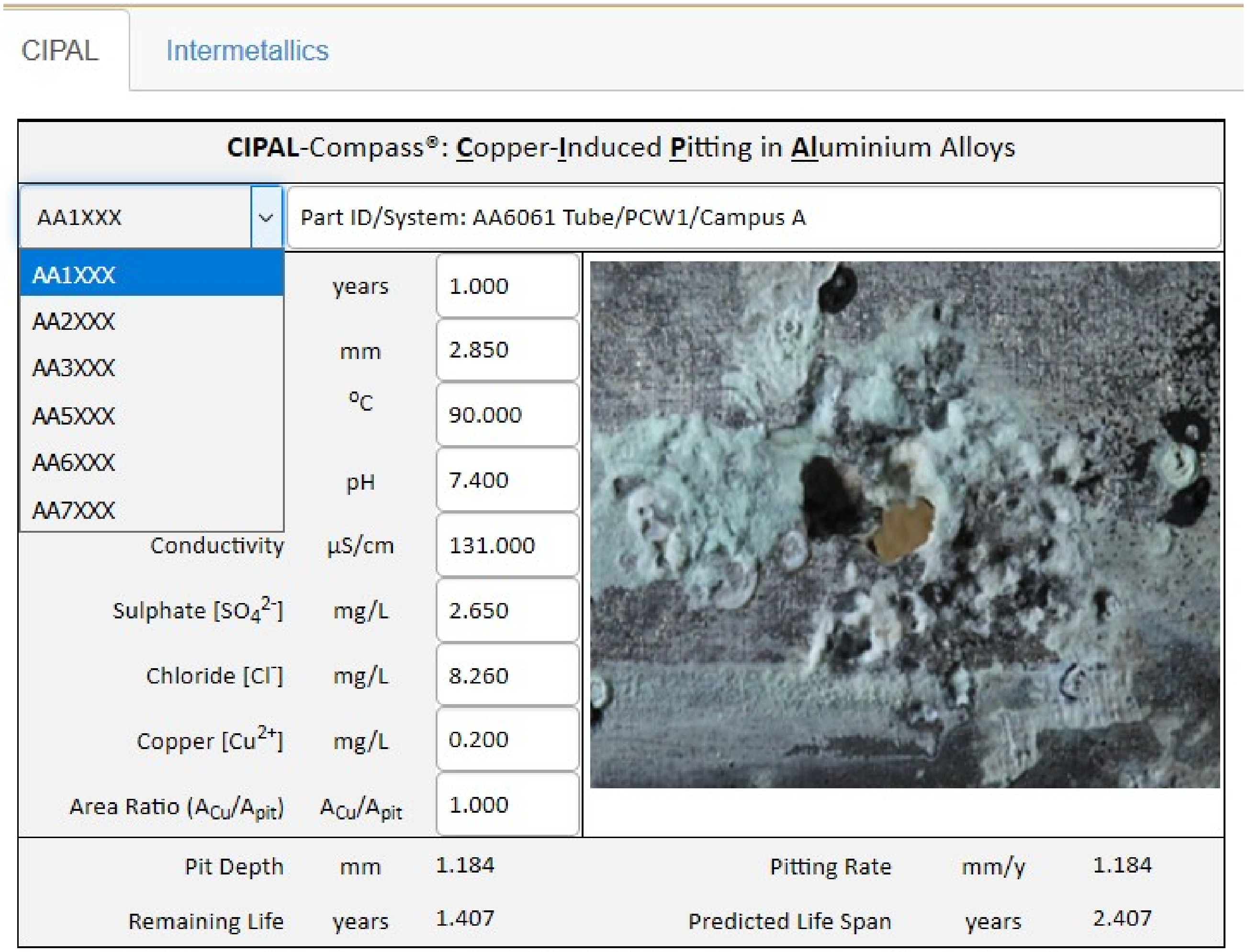

Figure 2 Selection of Aluminium Alloys Series in CIPAL-Compass

Users of CIPAL-Compass start by selecting the aluminum alloy series from the dropdown list. The specific grade of aluminium alloy in a particular series is not required as all grades within the same series showed similar corrosion behaviour.

After selecting the aluminium alloys series, the next step is to enter the chemistry parameters of the water or process fluid. Temperature, pH, conductivity and concentrations of sulphate, chloride, and copper ions are all critical factors that influences both the initiation of pitting and the propagation rate of pitting in aluminum alloys.

CIPAL-Compass also models the galvanic effect of copper deposition on the aluminium surface by taking into account of the surface area ratio of the copper deposit to the pit opening.

Service Life Prediction for Process Piping in Semiconductor Manufacturing

In semiconductor manufacturing, the process cooling water is frequently contaminated with copper ions, which will deposit on aluminium alloy AA6061 piping surface and induce pitting corrosion in aluminum alloy AA6061. The temperature of process cooling water is about 90°C and the pipe wall thickness is 2.85 mm. The chemistry of the process water is as entered. CIPAL-Compass predicts that the piping would leak in about 2.5 years after operation due to copper-induced pitting in the aluminum alloy.

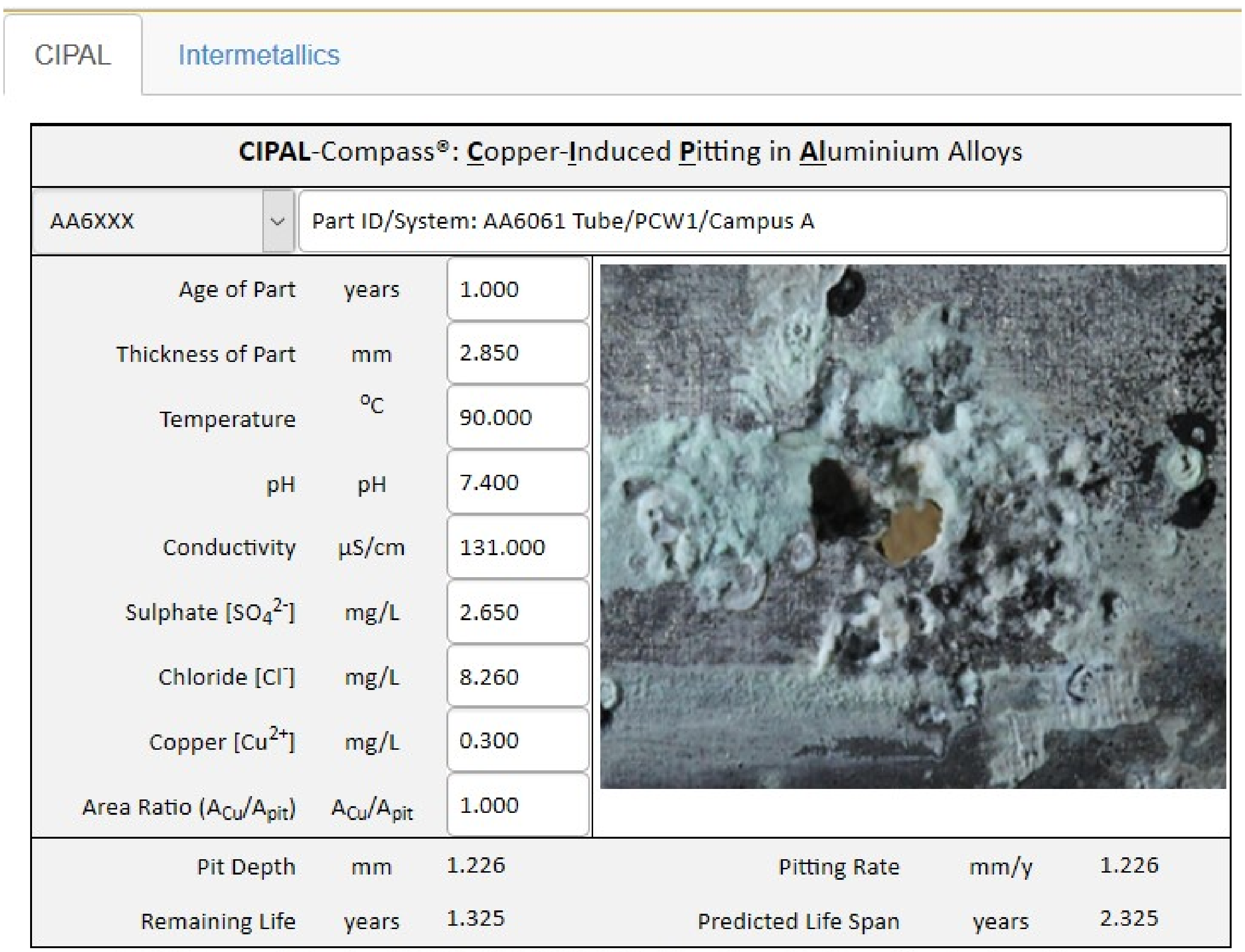

Figure 3 Service Life Prediction for Process Piping in Semiconductor Manufacturing

Overview of CIPAL-Compass for Intermetallics-Induced Pitting in Aluminum Alloys

Intermetallics, their size and distribution in aluminium alloys, are critical factors influencing the alloys' mechanical strength and corrosion resistance properties. Some intermetallics are anodic to the aluminum matrix while others are cathodic to the matrix. The anodic intermetallics will corrode preferentially, creating cavities/holes in the aluminium matrix (Figure 4). The cathodic intermetallics will not corrode themselves but causing corrosion of the matrix around their perimeters (Figure 5). Figures below show overviews of the CIPAL-Compass module for Intermetallics-Induced Pitting in Aluminum Alloys.

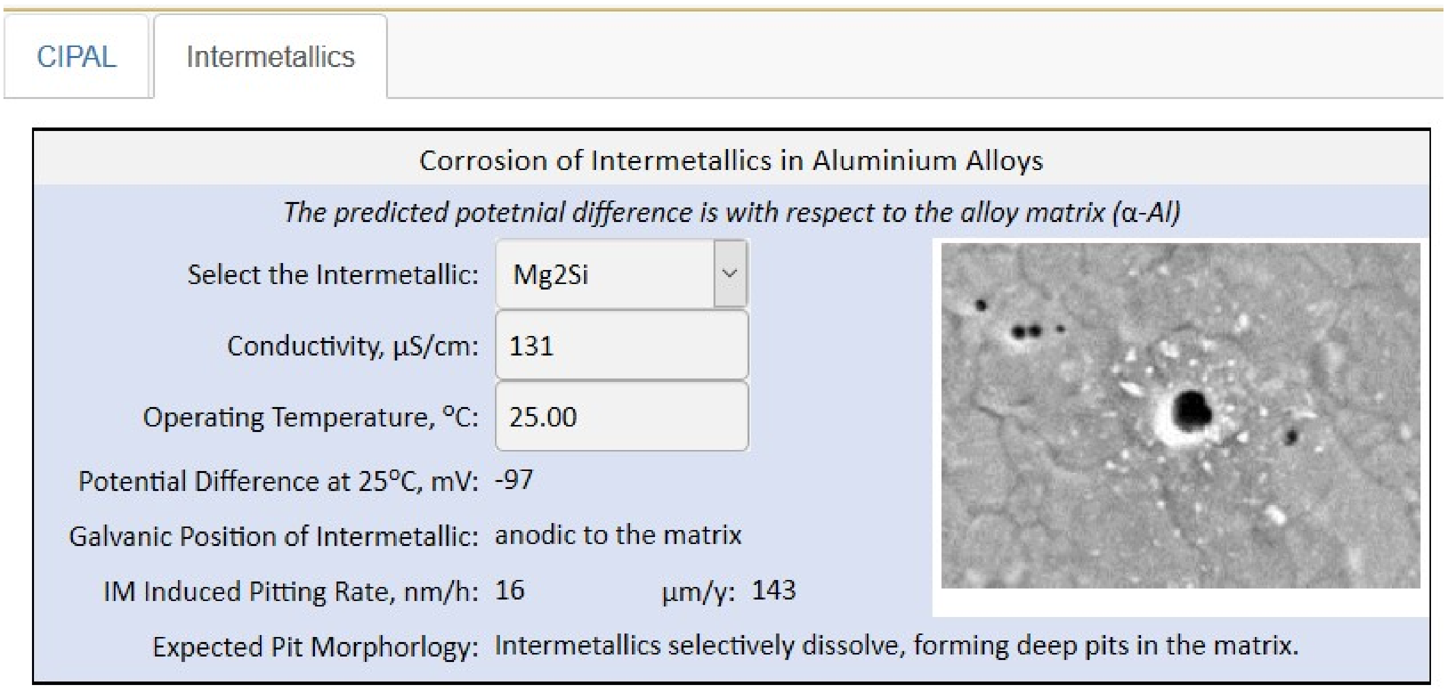

Figure 4 Overview of CIPAL-Compass for Intermetallics-Induced Pitting in Aluminum Alloys

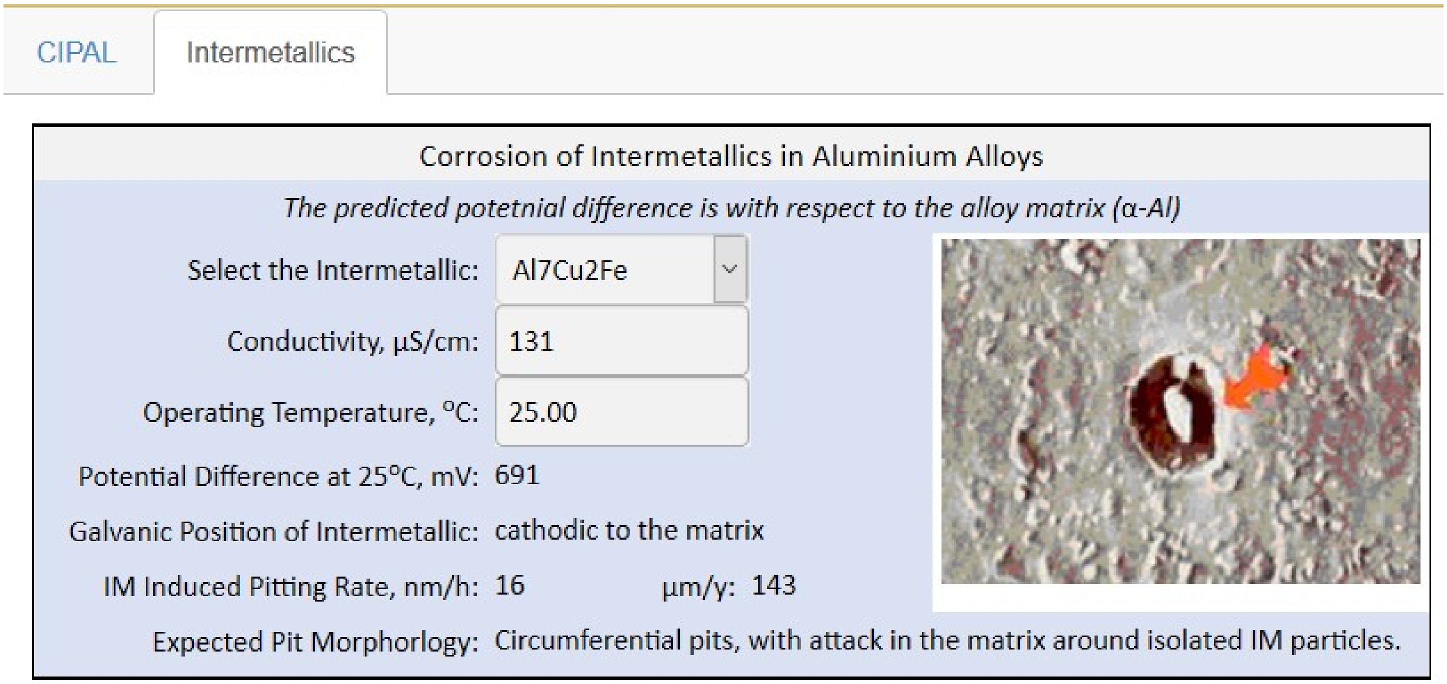

Figure 5 Overview of CIPAL-Compass for Intermetallics-Induced Pitting in Aluminium Alloys

A dozen of intermetallics commonly found in aluminium alloys are available for selection in CIPAL-Compass (Figure 6). If you cannot find the intermetallics of your interest in the list, do let us know through the Contact Us link and we will conduct the necessary tests to generate the required data for inclusion in the software.

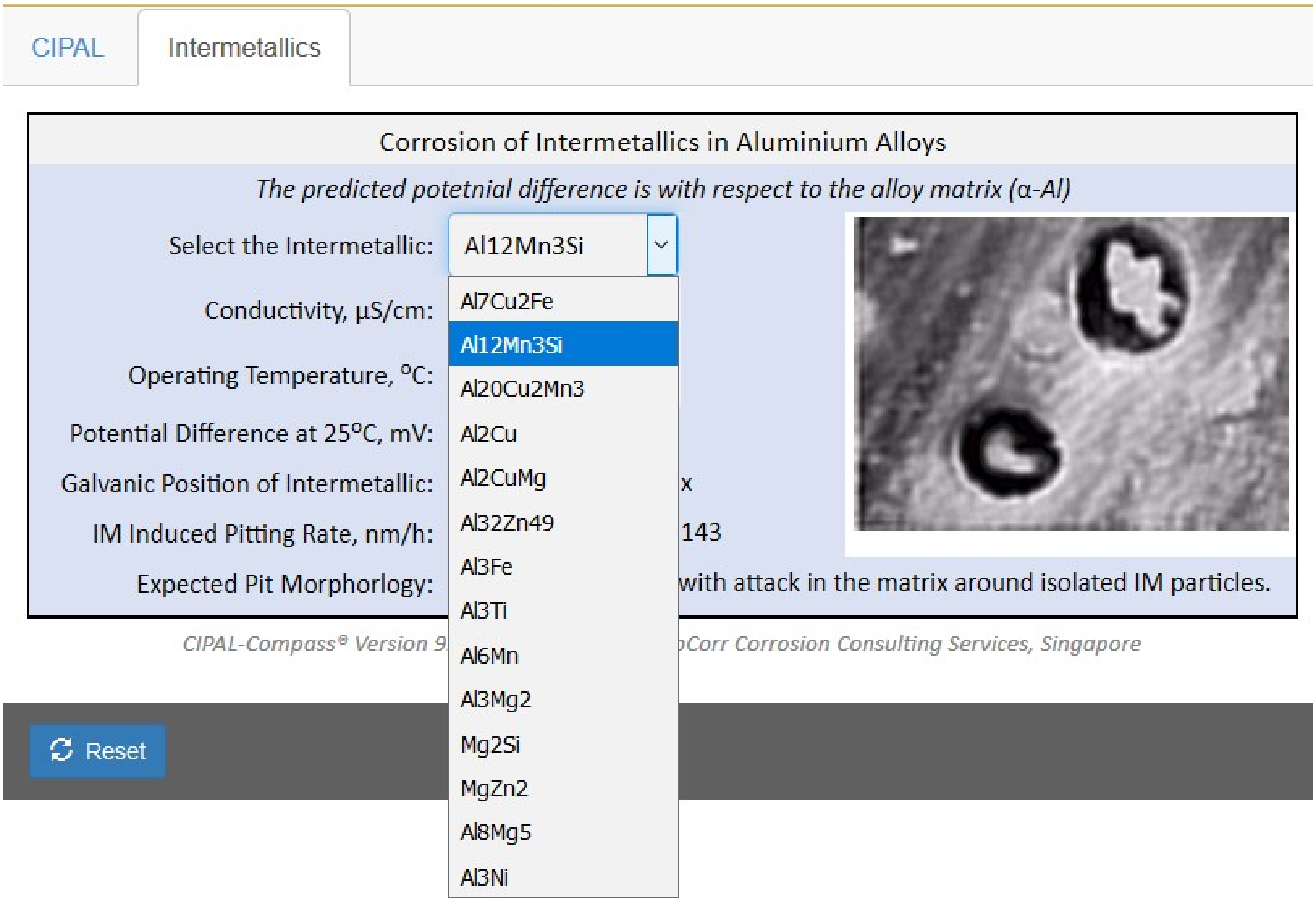

Figure 6 Common Intermetallics in Aluminium Alloys in CIPAL-Compass

Users simply enter the conductivity and the operating temperature of the process water/fluids, CIPAL-Compass takes care of the rest.

Outputs from CIPAL-Compass includes the following:

- Predicted potential difference (at 25°C) with respect to the alloy matrix (α-Al). The greater the potential difference, the greater the galvanic effect between the IM particles and the matrix.
- The galvanic position of the selected intermetallic with respect to the alloy matrix. The intermetallic can be anodic to the matrix or cathodic to the matrix, depending on the composition of the intermetallic.

- The intermetallic-induced pitting rate in nano-meter per hour (nm/h), and micro-meter per year (μm/y).
- The expected pit morphology. For intermetallics anodic to the matrix, the intermetallics themselves will be preferentially dissolved, leading to the formation of deep pits in the alloy matrix (see Figure 4 above). For intermetallics cathodic to the matrix, the intermetallics act as cathodes in the corrosion process and they are not subject to corrosion. However, the matrix is the anode in the corrosion process and corrodes around the isolated IM particles, leading to the formation of circumferential pits with the IM particles remain in the center (see Figure 5 above). Eventually, the IM particles will fall out of the pit holes.

WebCorr can customize CIPAL-Compass for your specific process fluids and alloys used in any industry from general engineering to wafer fabrication.

CIPAL-Compass, giving you the right directions in Pitting Prediction in Aluminum Alloys