The solder alloy may be in the form of one of a bar, a stick, a solid or flux cored wire, a foil or strip, or a powder or paste, or solder spheres for use in ball grid arrays or chip scale packages, or other pre-formed solder pieces.

The solder alloy may be used to fabricate a solder joint. Thus, in an aspect, there is provided a solder joint formed by the solder alloy as disclosed above. In another aspect, Aa method of forming a solder joint with the solder alloy as disclosed above is also disclosed.

Another aspect of the present disclosure is directed to a lead-free, silver-free solder alloy consisting of 0.001 to 0.800 % by weight copper, 0.001 to 0.050 % by weight nickel, 0.001 to 0.012 % by weight phosphorus, 0.001 to 0.008 % by weight gallium, and balance tin, together with unavoidable impurities. In one embodiment, copper is 0.600 to 0.800 % by weight of the solder alloy.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

There are a number of requirements for a solder alloy to be suitable for use in wave soldering, reflow soldering, hot air levelling processes, ball grid arrays, and other assembly processes. For example, the alloy must exhibit good wetting characteristics in relation to a variety of substrate materials such as copper, nickel, nickel phosphorus ("electroless nickel"). Such substrates may be coated to improve wetting, for example by using tin alloys, gold or organic coatings (OSP). Good wetting also enhances the ability of the molten solder to flow into a capillary gap, and to climb up the walls of a through-plated hole in a printed wiring board, to thereby achieve good through hole filling.

Solder alloys tend to dissolve the substrate and to form an intermetallic compound at the interface with the substrate. For example, tin in the solder alloy may react with the substrate at the interface to form an inter metallic compound layer. If the substrate is copper, then a layer of $Cu_6Sn_5$ will be formed. Such a layer typically has a thickness of from a fraction of a micron to a few microns. At the interface between this layer and the copper substrate an intermetallic compound of $Cu_3Sn$ may be present. The interface intermetallic layers will tend to grow during aging, particularly where the service is at higher temperatures, and the thicker intermetallic layers, together with any voids that may have developed may further contribute to premature fracture of a stressed joint.

Other factors are: (i) the presence of intermetallics in the alloy itself, which results in improved mechanical properties; (ii) oxidation resistance, which is important in solder spheres