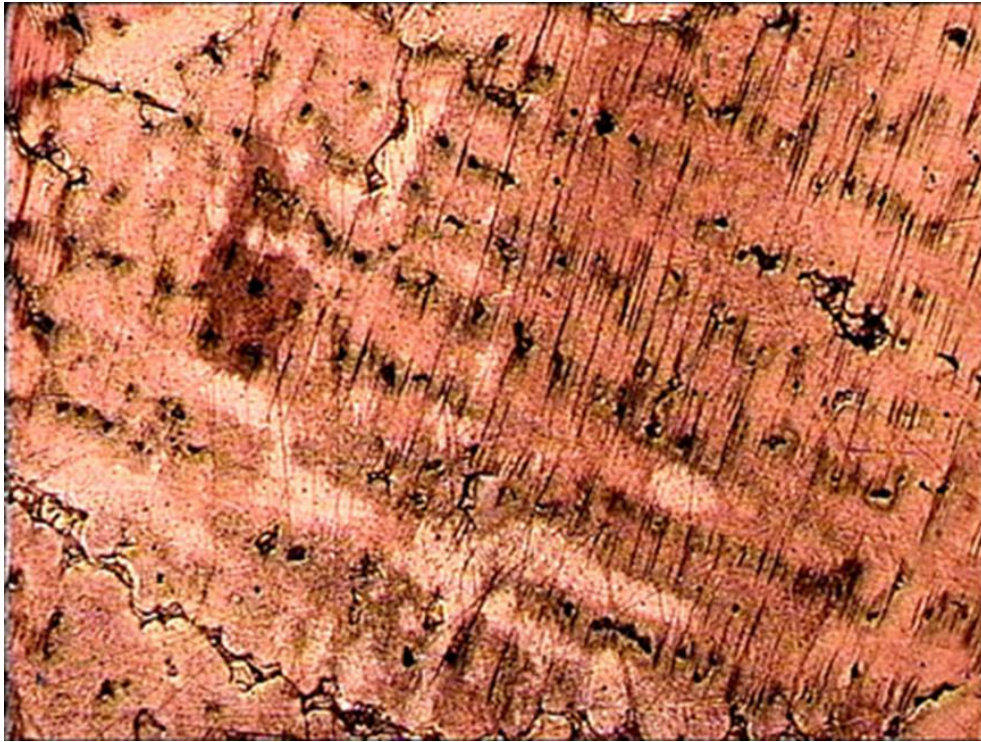
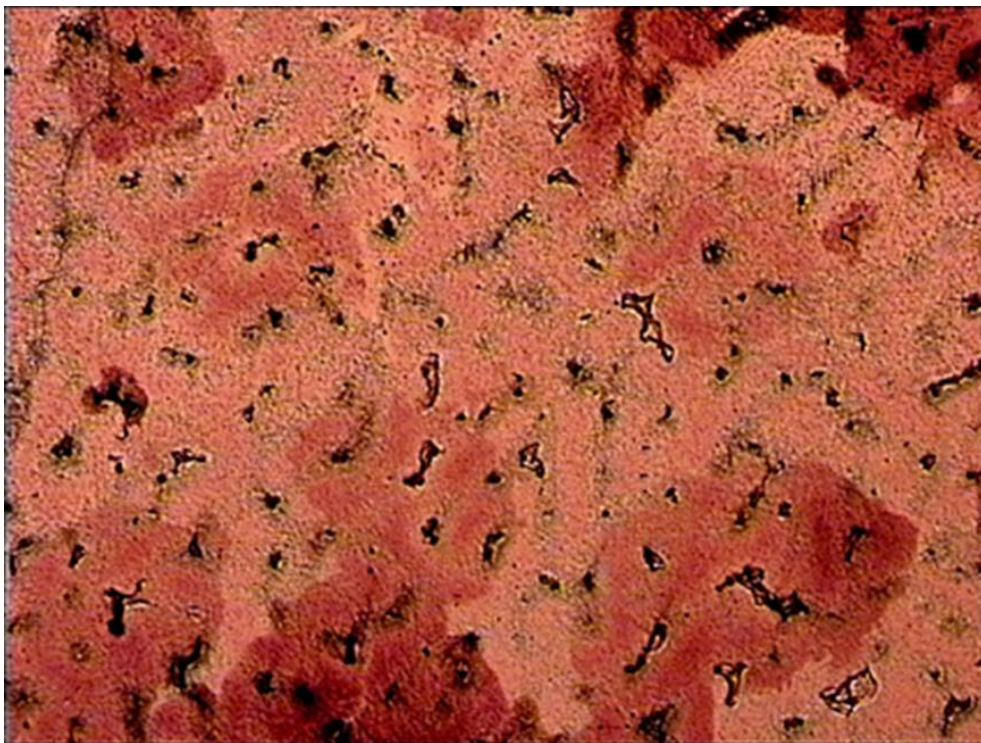


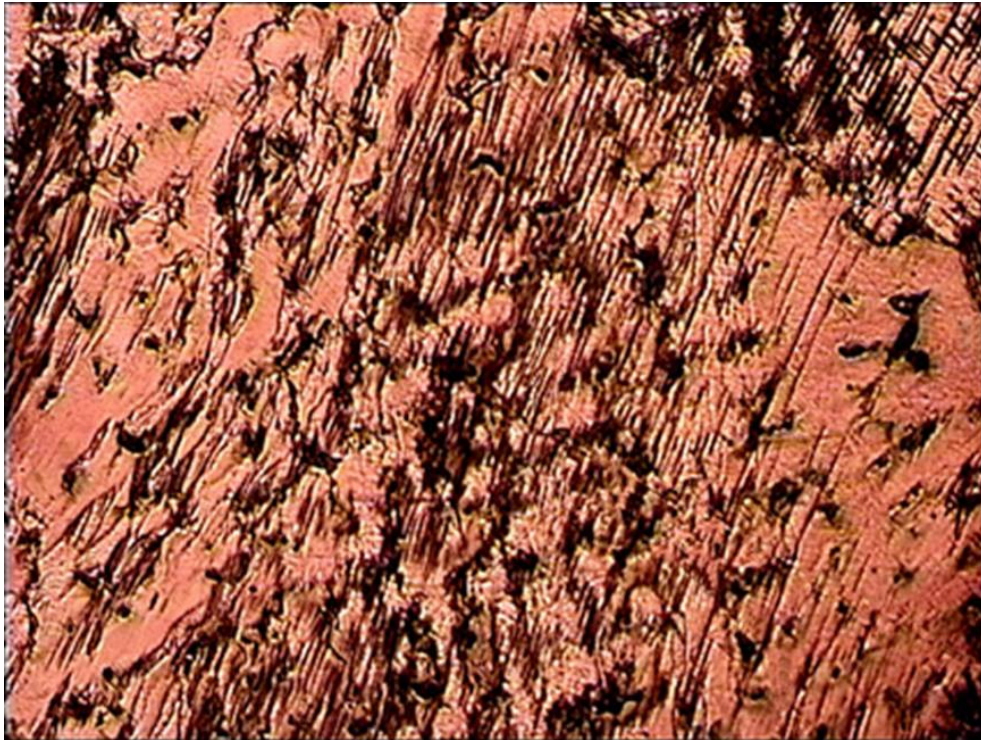
Appendix 5: Colour photomicrographs of the series of cold working and annealing



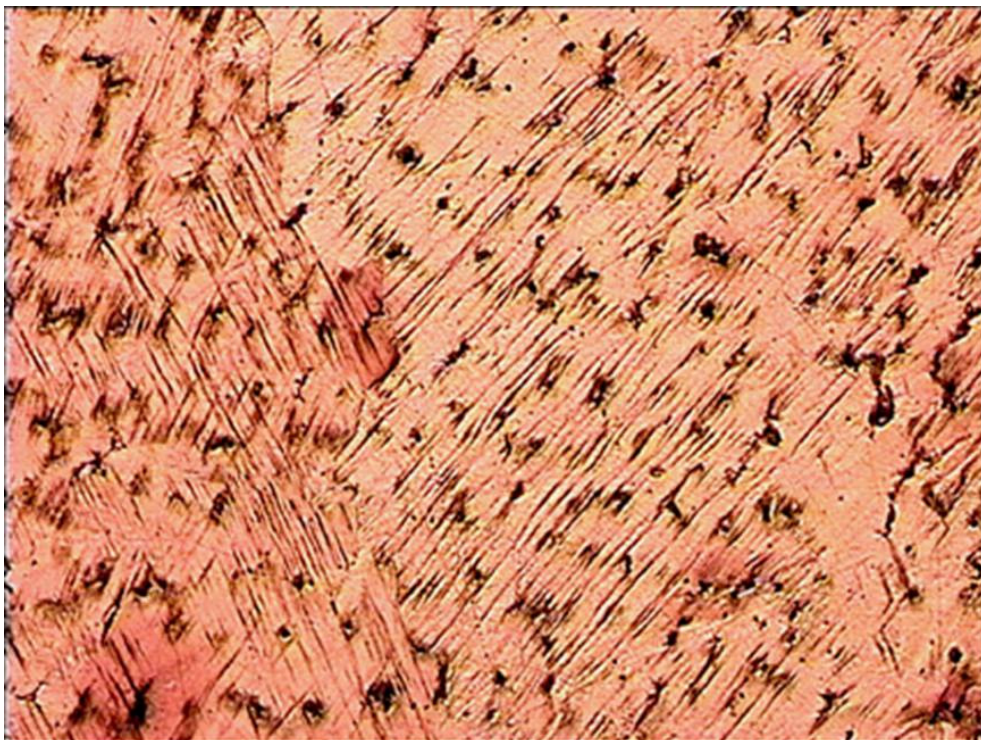
a. surface of 10% reduction, image width 0.65mm



b. centre of 10% reduction, image width 0.65mm



c. surface of 30% reduction, image width 0.65mm

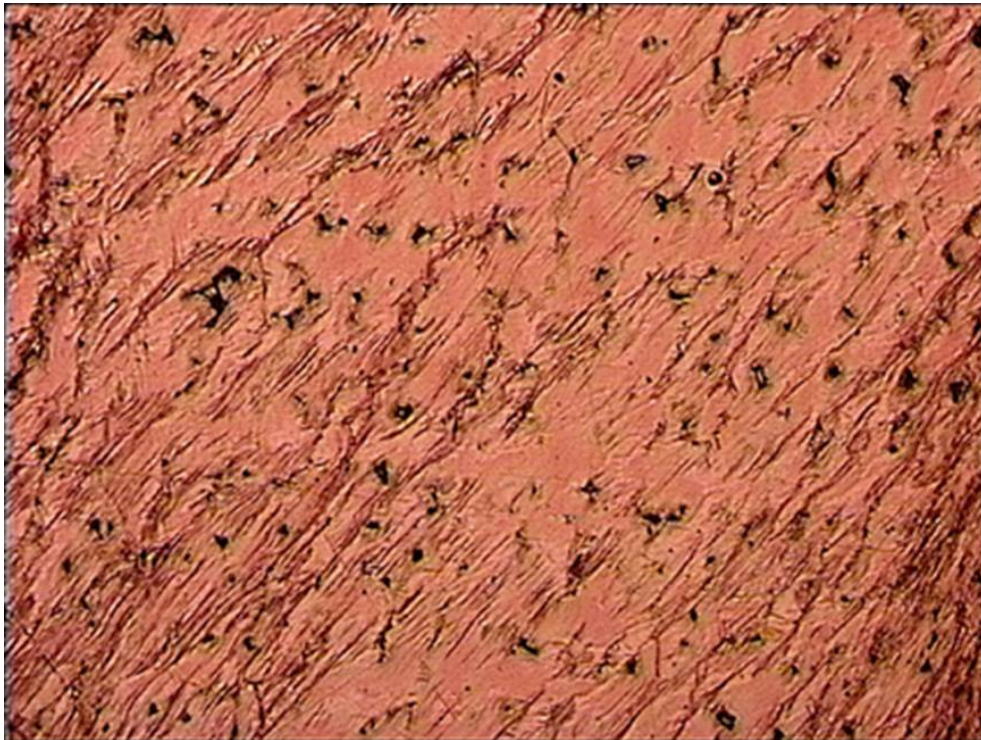


d. centre of 30% reduction, image width 0.65mm

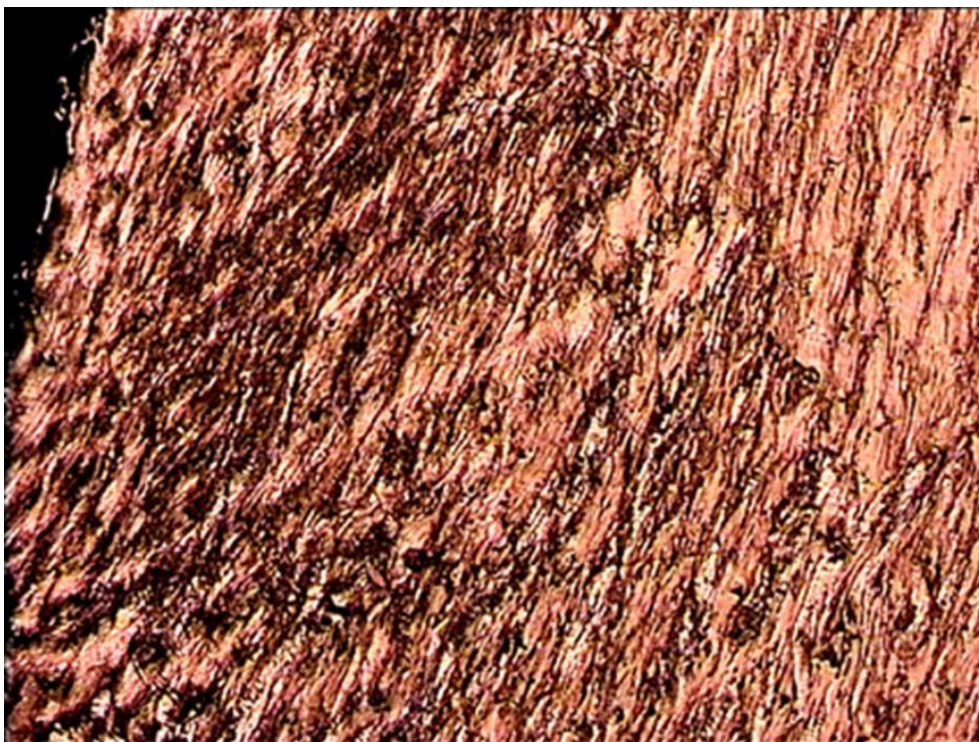
Appendix 5: Colour photomicrographs of the series of cold working and annealing



e. surface of 45% reduction, image width 0.65mm



f. centre of 45% reduction, image width 0.65mm

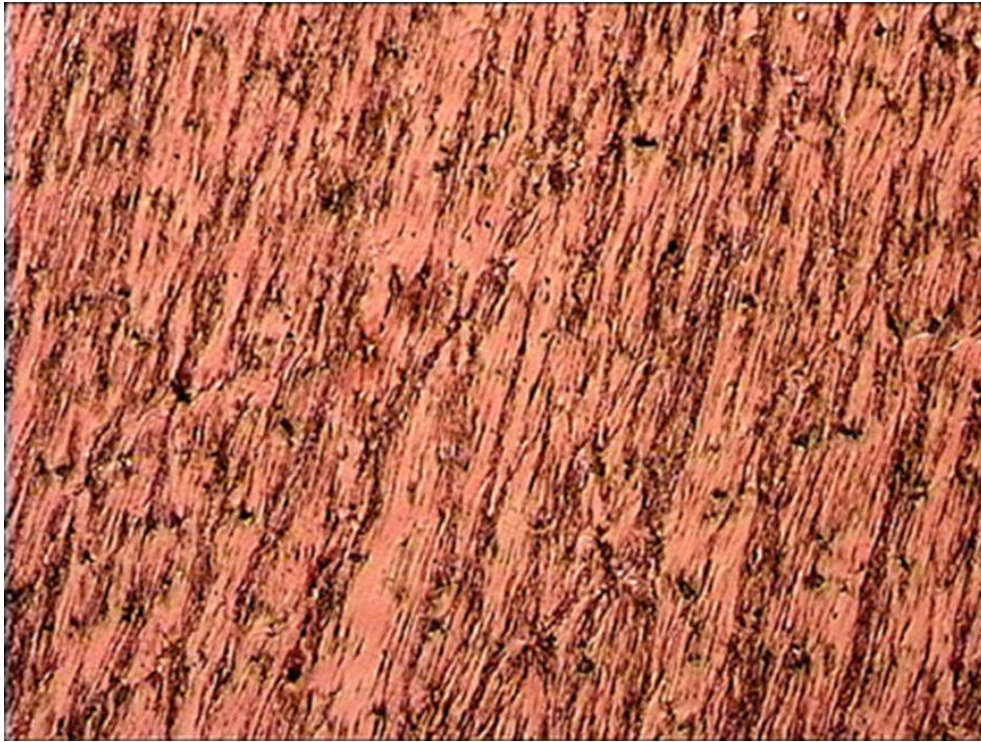


g. surface of 60% reduction, image width 0.65mm

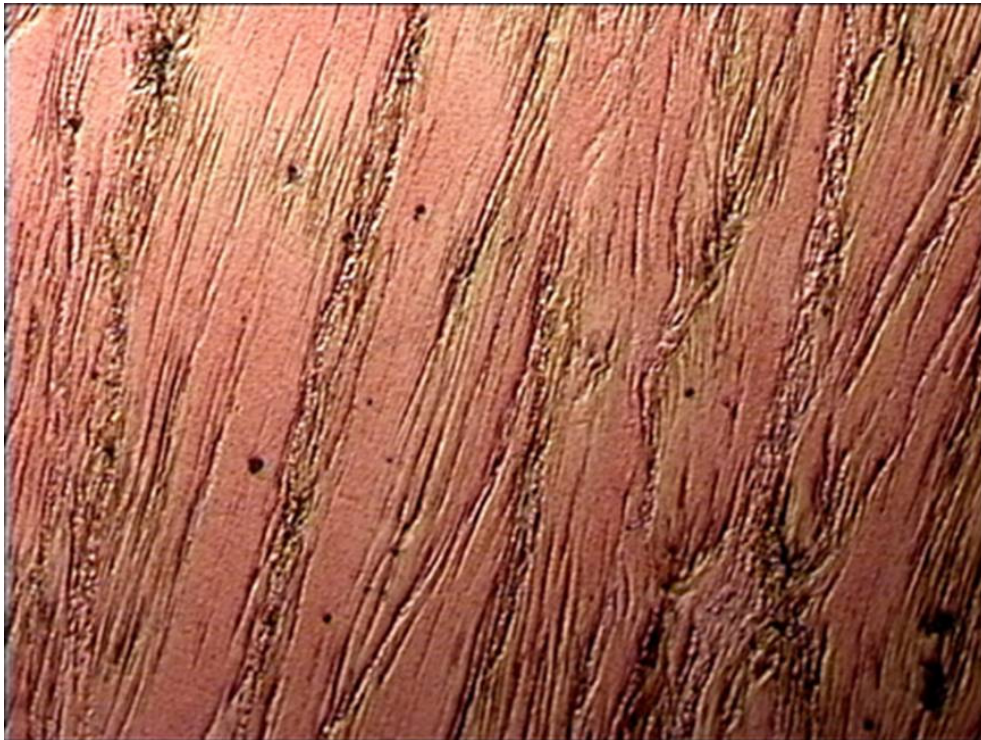


h. the same location as above at higher magnification, image width 0.13mm

Appendix 5: Colour photomicrographs of the series of cold working and annealing



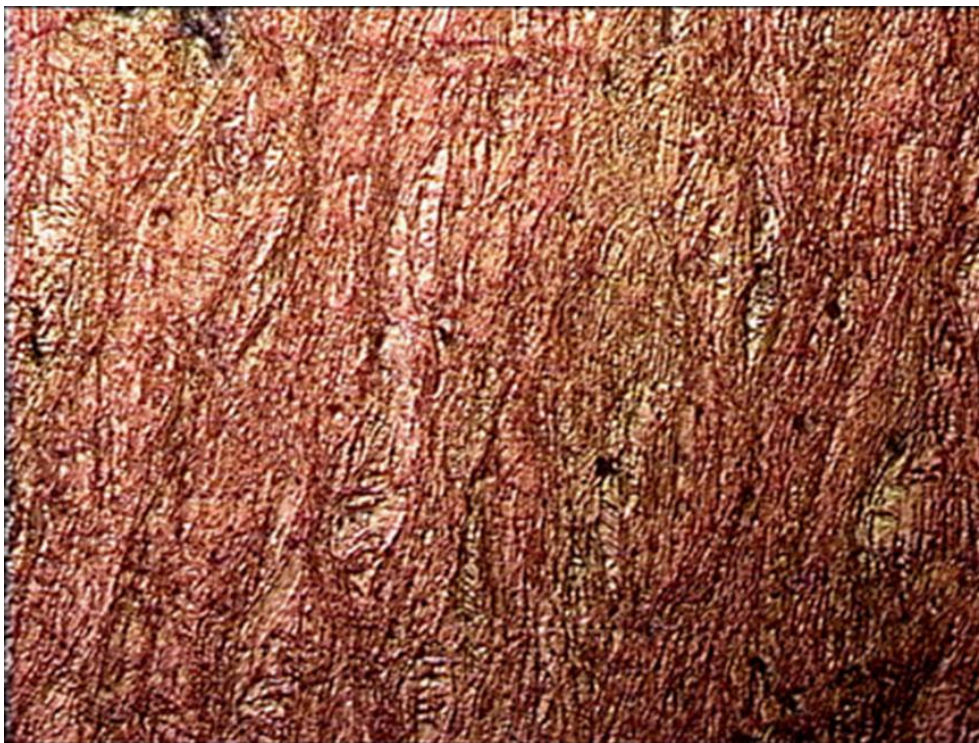
i. centre of 60% reduction, image width 0.65mm



j. same location as above at higher magnification, image width 0.13mm



k. surface of 80% reduction, image width 0.13mm



l. centre of 80% reduction, image width 0.13mm

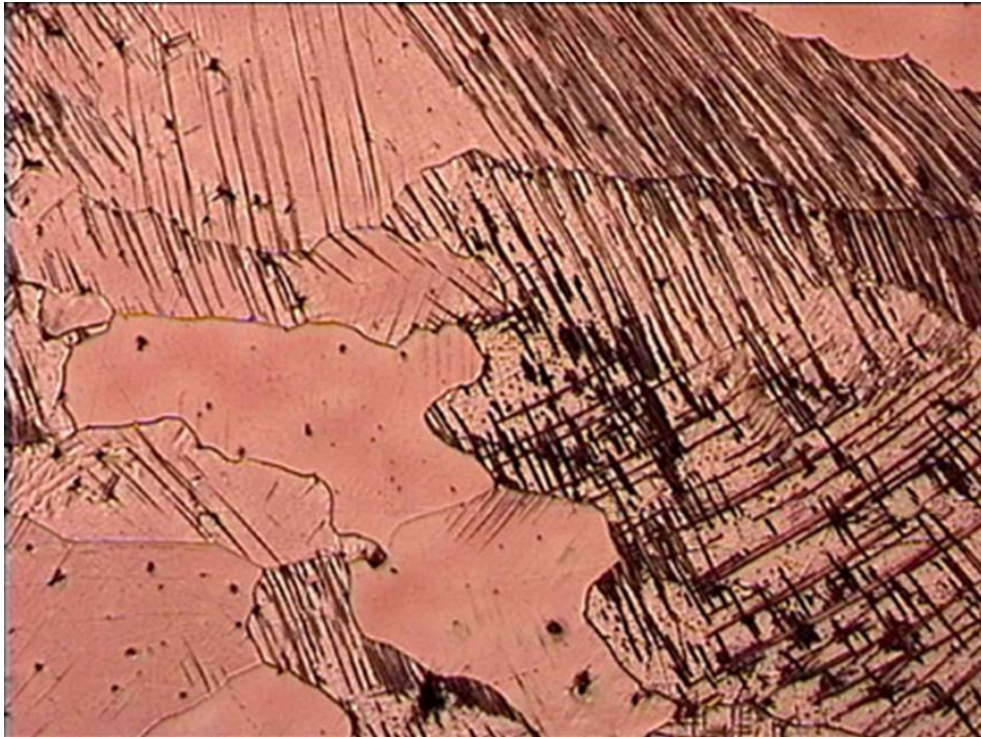


m. surface of 95% reduction, image width 65 μ m

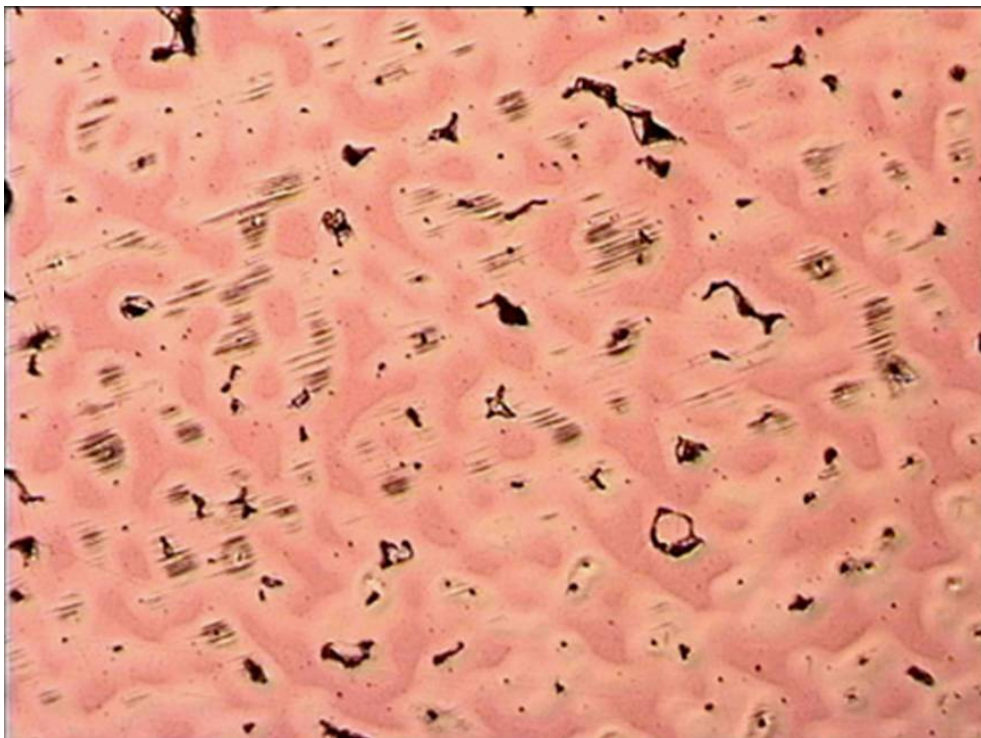


n. centre of 95% reduction, image width 65 μ m

Figure CR1. Cold-rolled 6% Sn bronze, cast in sand/water-quenched at various reductions.

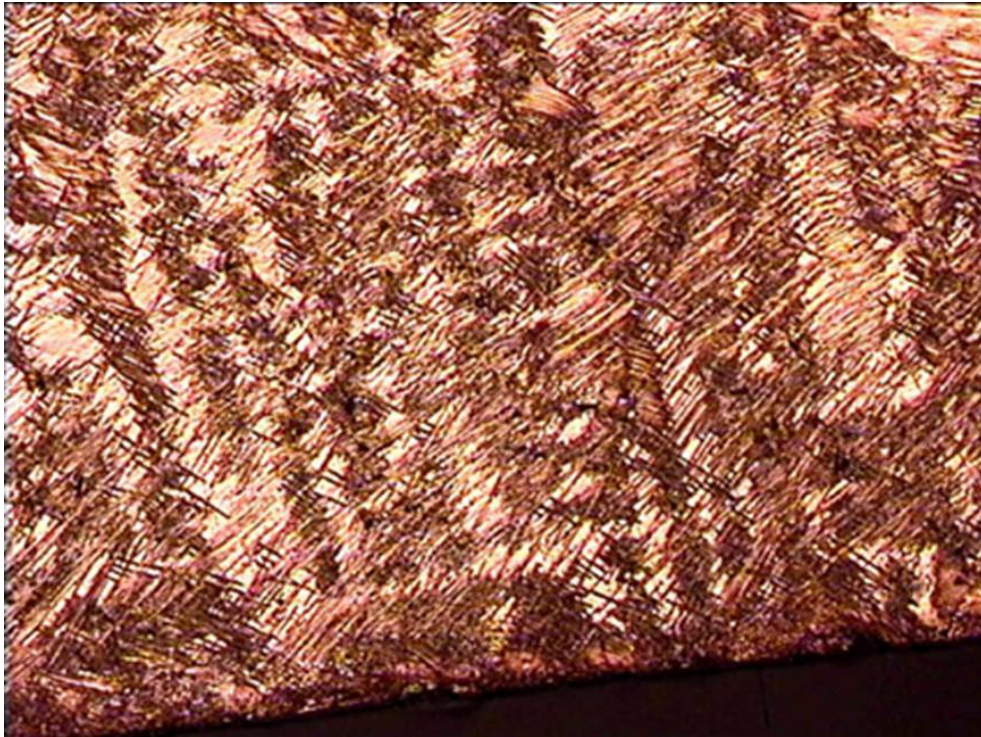


a. surface of 10% reduction, image width 0.65mm

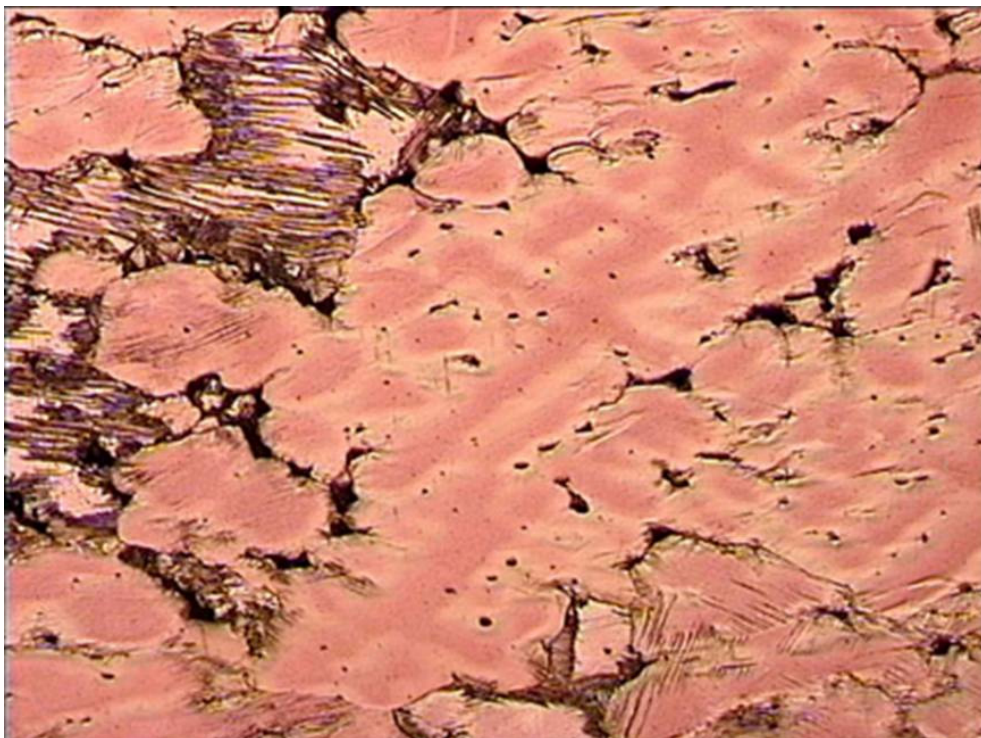


b. centre of 10% reduction, image width 0.65mm

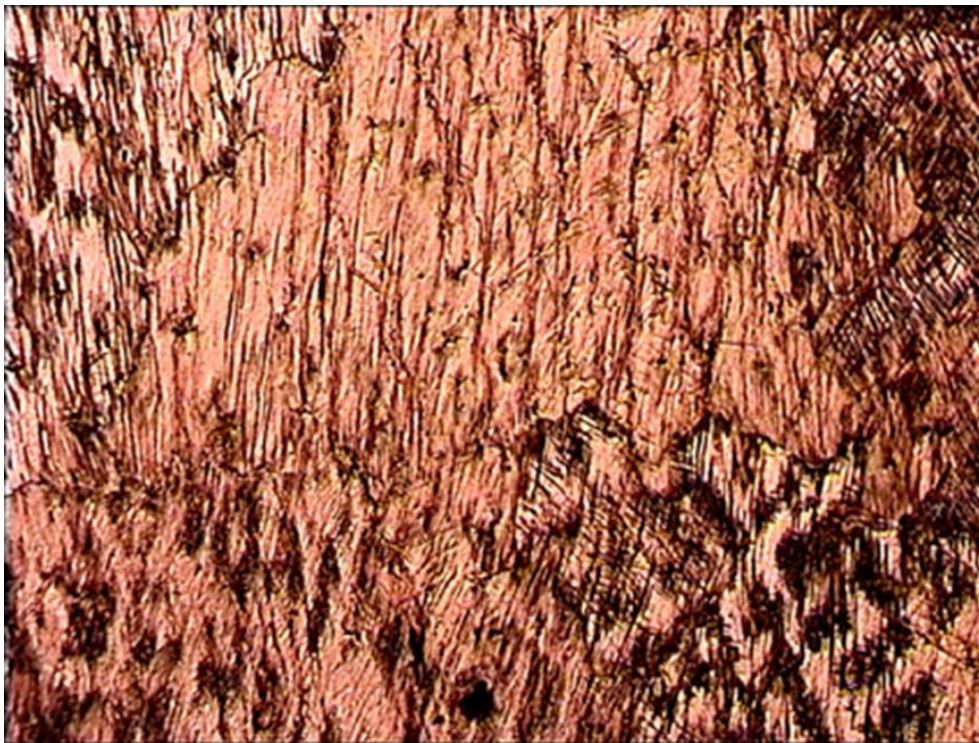
Appendix 5: Colour photomicrographs of the series of cold working and annealing



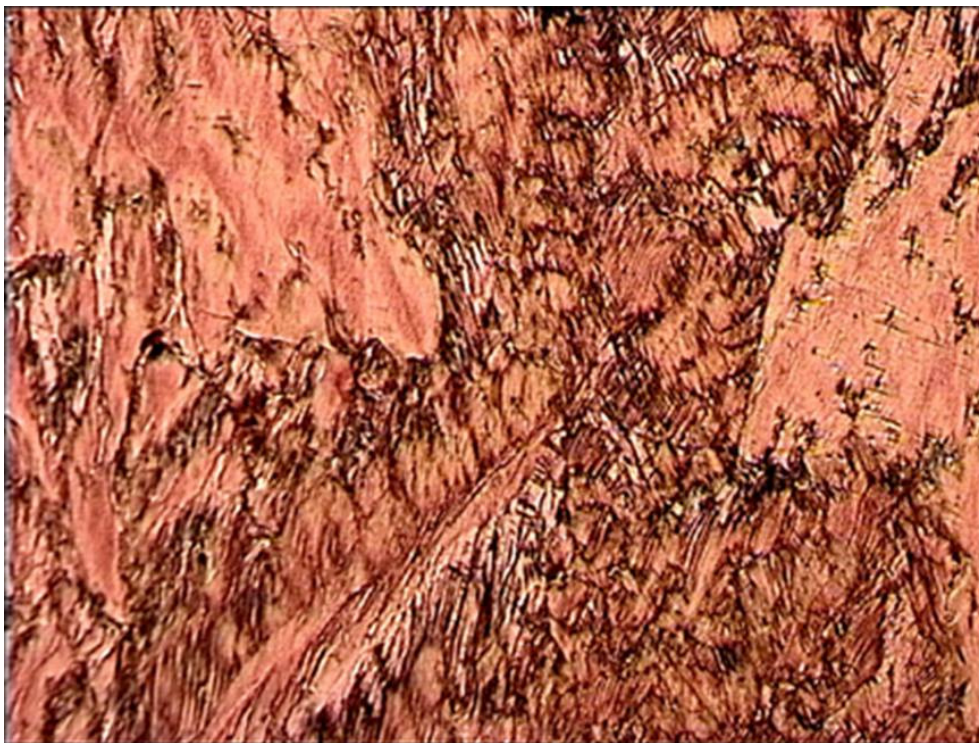
c. surface of 30% reduction, image width 0.65mm



d. centre of 30% reduction, image width 0.65mm



e. surface of 45% reduction, image width 0.65mm

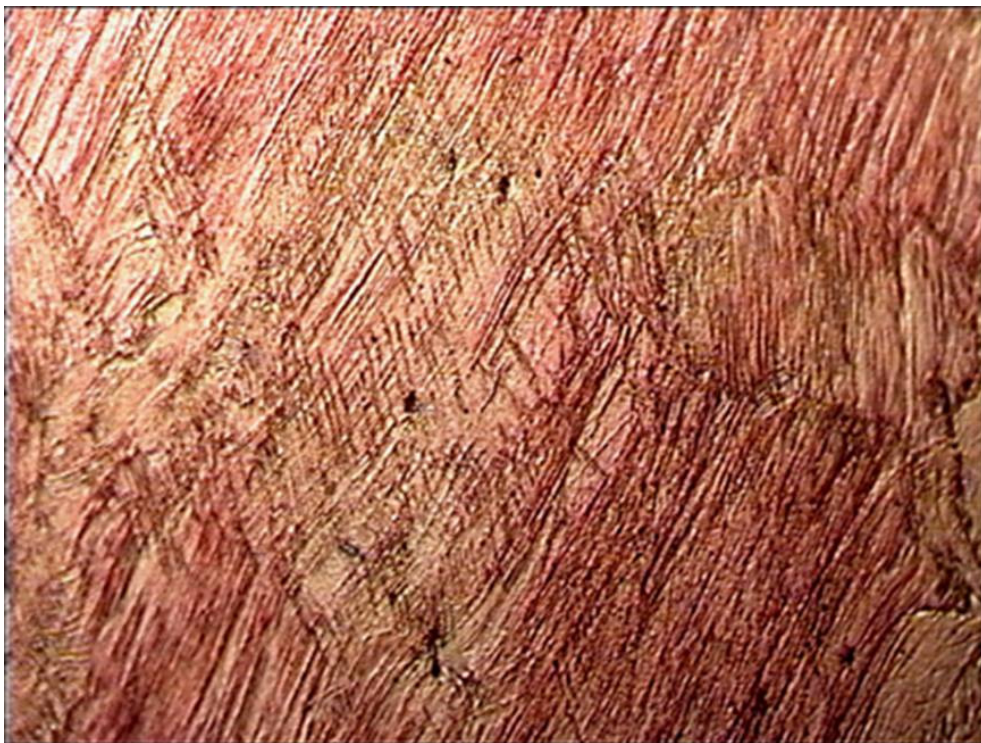


f. centre of 45% reduction, image width 0.65mm

Appendix 5: Colour photomicrographs of the series of cold working and annealing



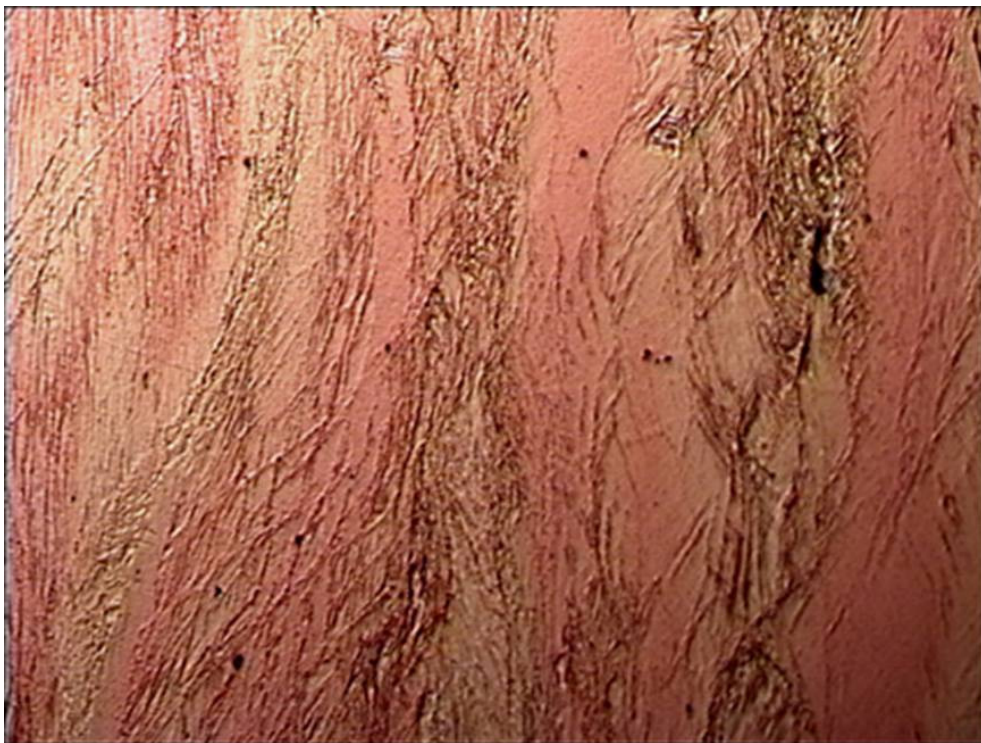
g. surface of 60% reduction, image width 0.65mm



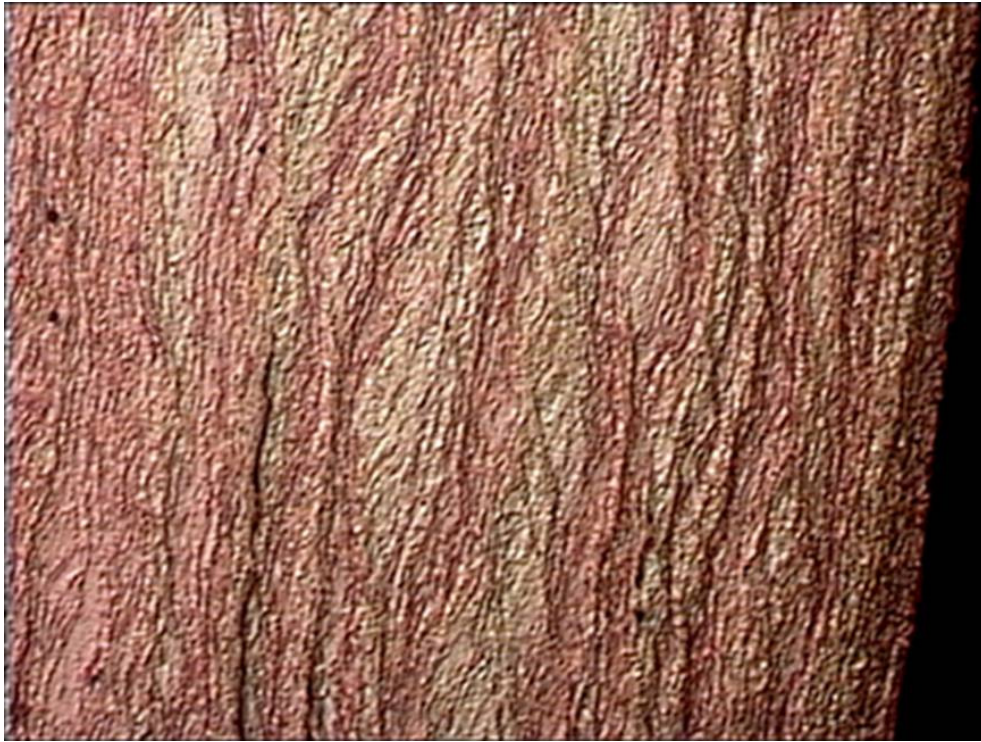
h. centre of 60% reduction, image width 0.65mm



i. surface of 80% reduction, image width 0.65mm



j. centre of 80% reduction, image width 0.13mm

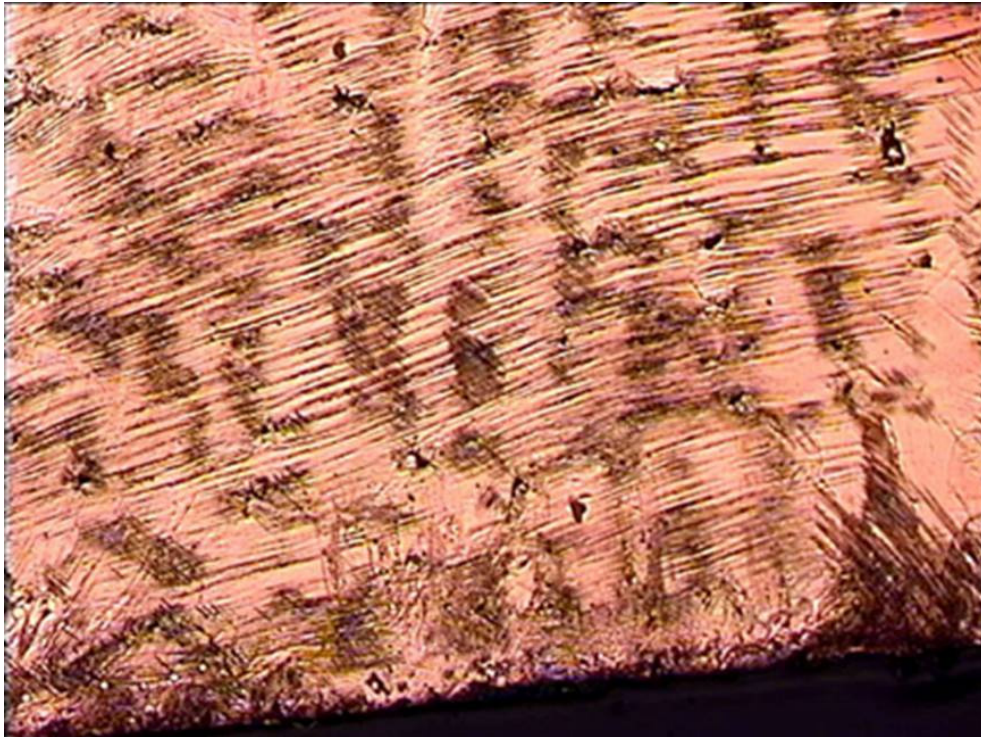


k. surface of 90% reduction, image width 0.13mm

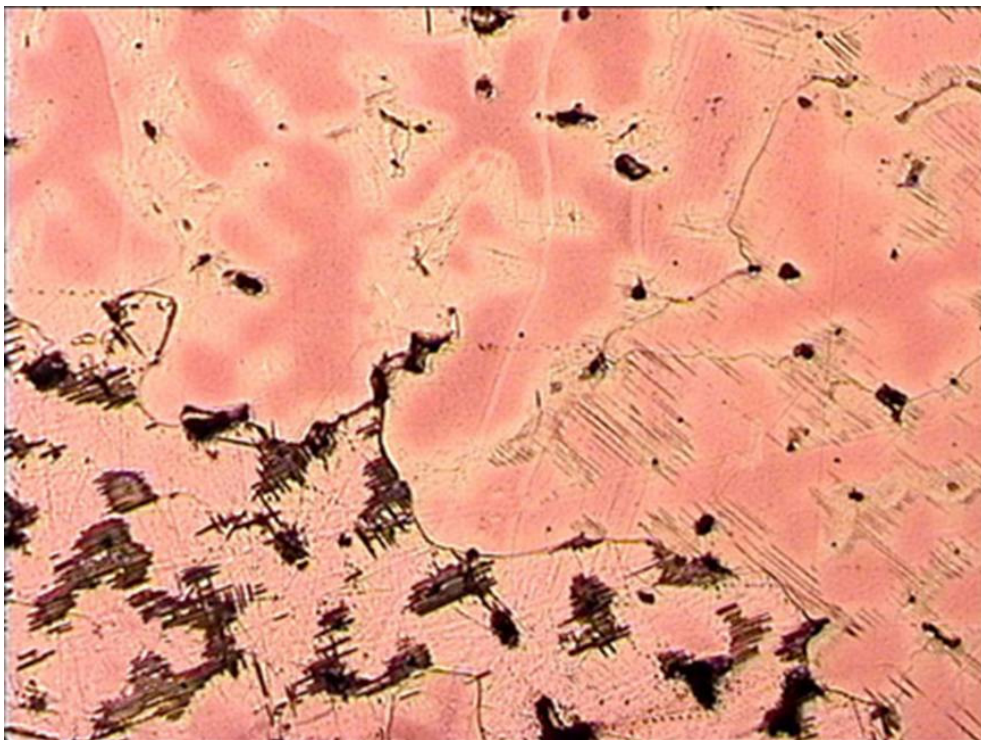


l. centre of 90% reduction, image width 0.13mm

Figure CR2. Cold-rolled 6% Sn bronze, cast in sand/air-cooled at various reductions.

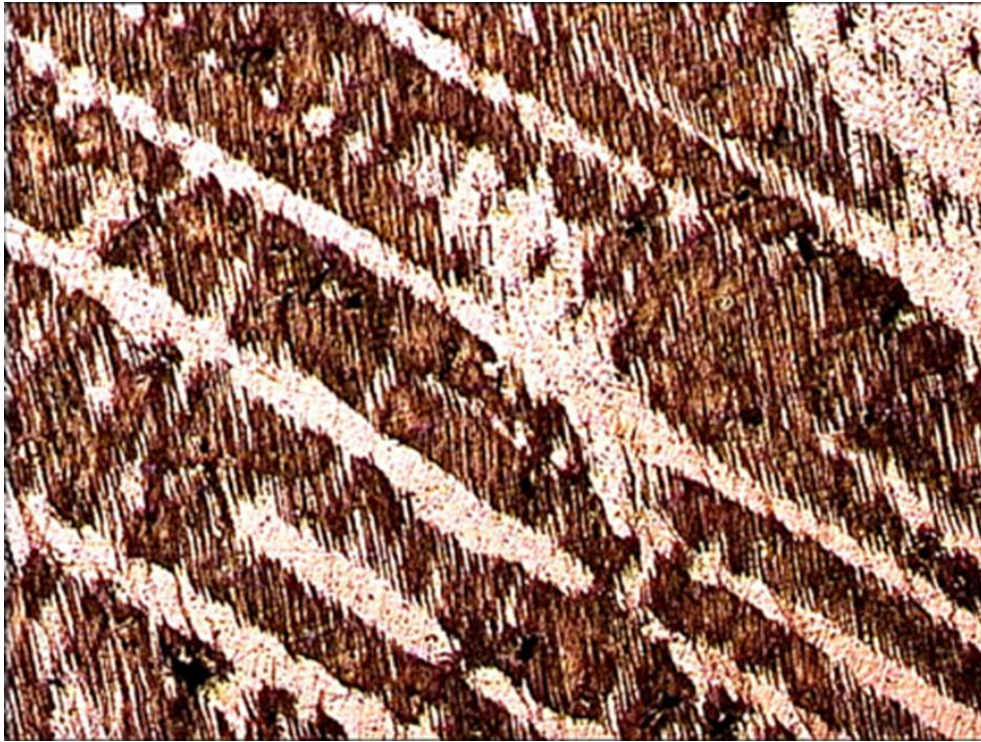


a. surface of 10% reduction, image width 0.65mm

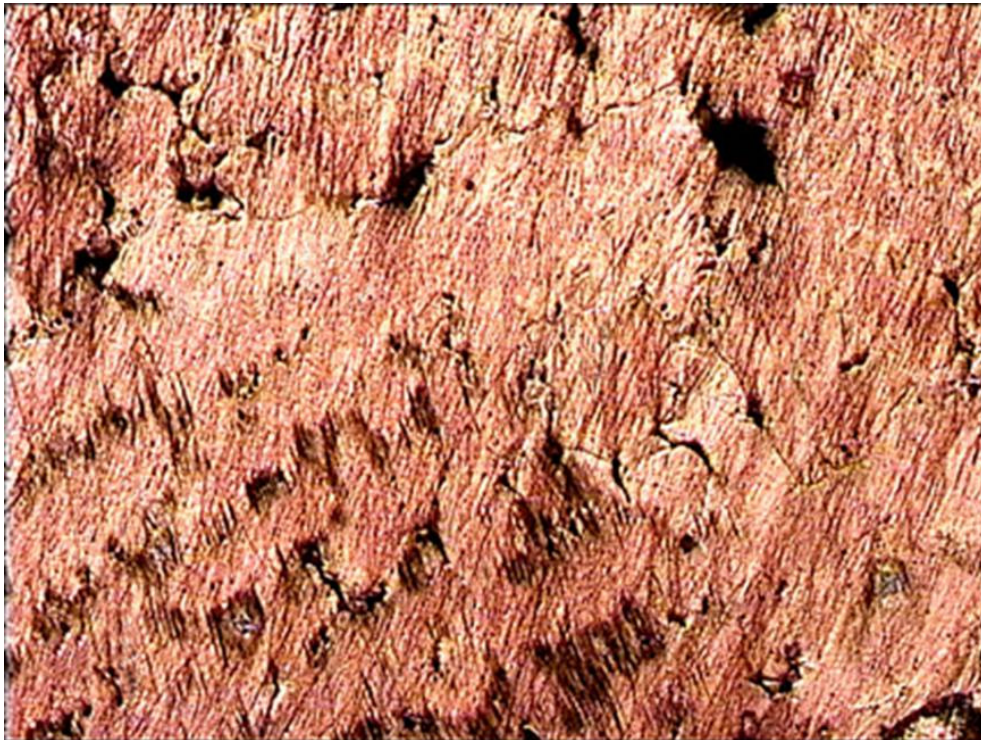


b. centre of 10% reduction, image width 0.65mm

Appendix 5: Colour photomicrographs of the series of cold working and annealing



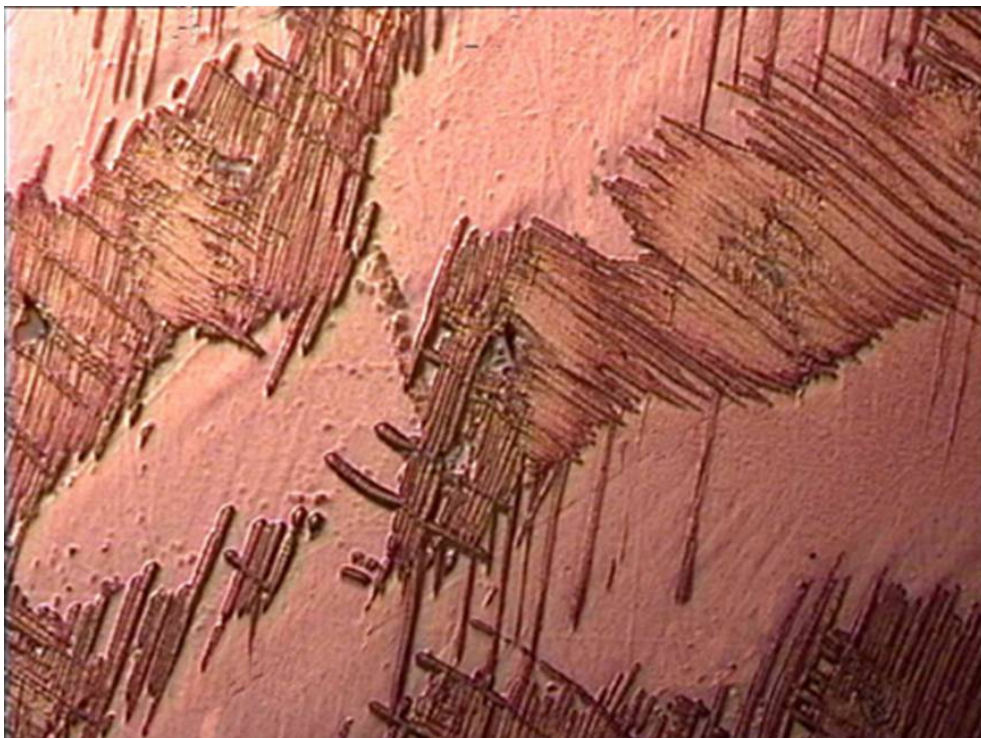
c. surface of 30% reduction, image width 0.65mm



d. centre of 30% reduction, image width 0.65mm

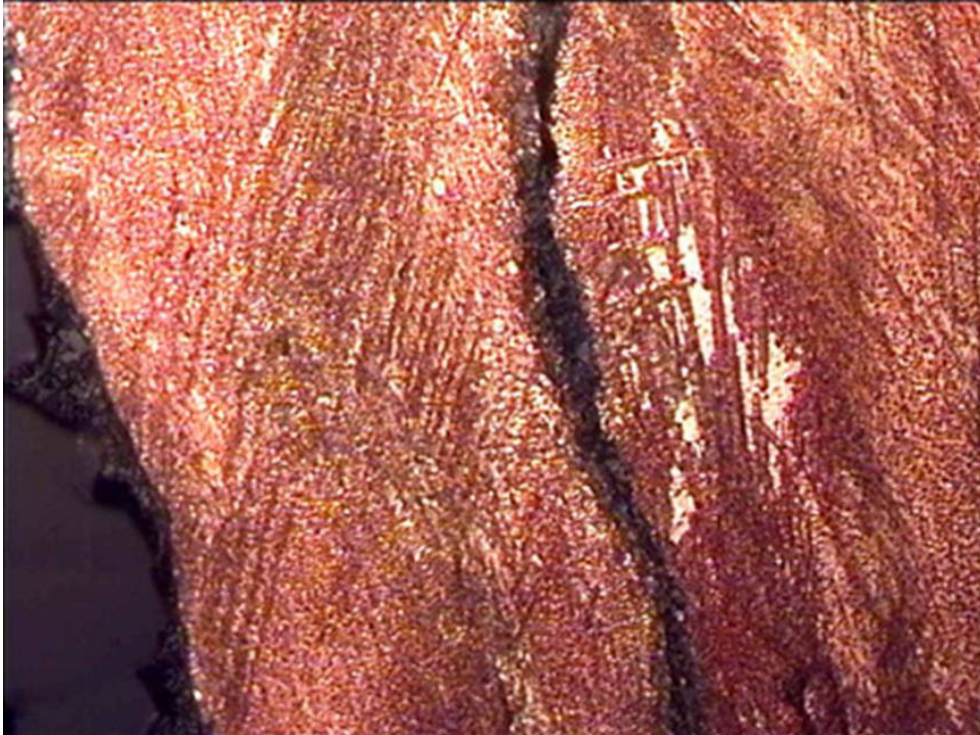


e. surface of 45% reduction, image width 0.13mm



f. centre of 45% reduction, image width 0.13mm

Appendix 5: Colour photomicrographs of the series of cold working and annealing



g. surface of 60% reduction, image width 0.13mm



h. centre of 60% reduction, image width 0.13mm

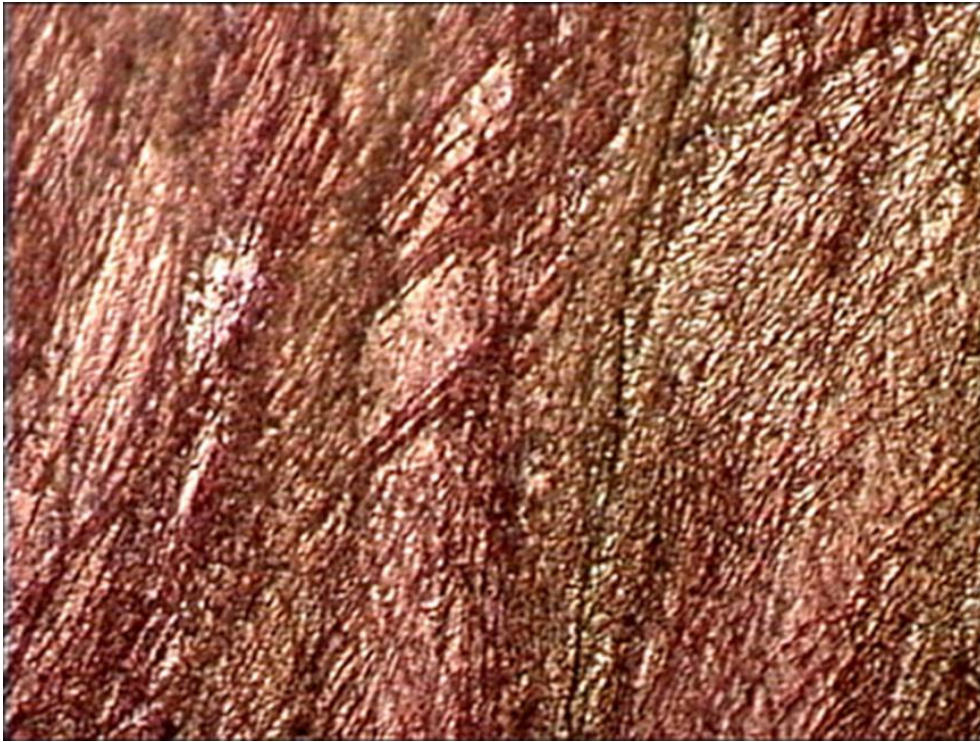


i. 60% reduction, showing elongation of sulphide inclusion. Image width 0.13mm



j. 60% reduction, showing unaffected $\alpha+\delta$ eutectoid. Image width 0.13mm

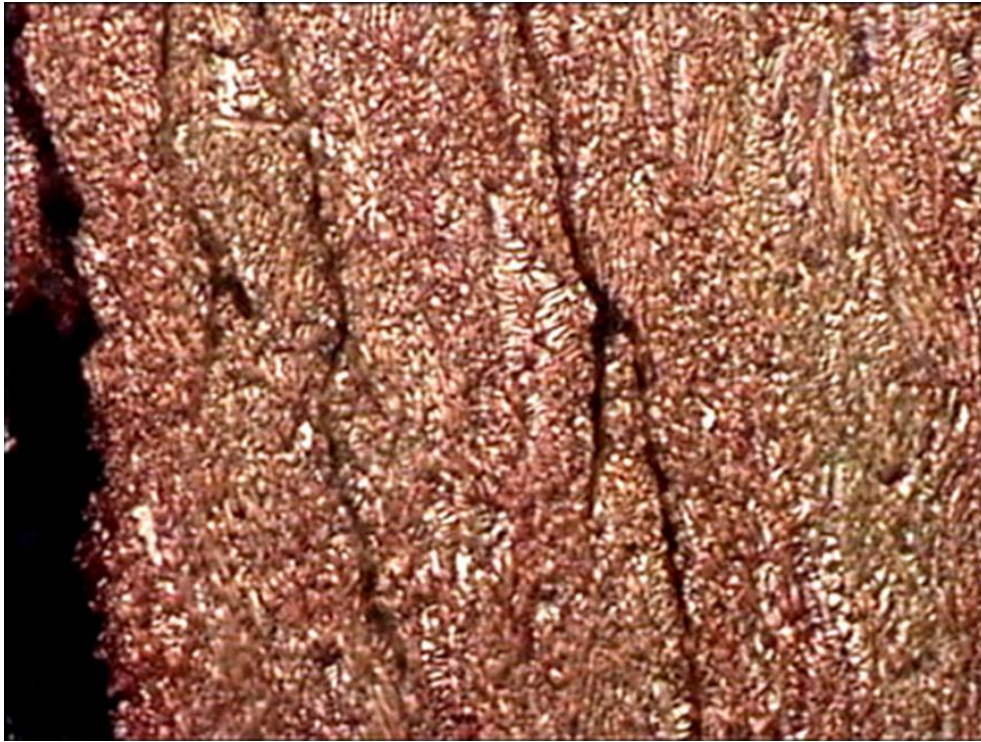
Appendix 5: Colour photomicrographs of the series of cold working and annealing



k. surface of 80% reduction, image width 65 μ m



l. centre of 80% reduction, showing a deformed $\alpha + \delta$ eutectoid. Image width 65 μ m



m. surface of the sample a reduction of 92% after annealing, showing many cracks. Image width 65 μ m



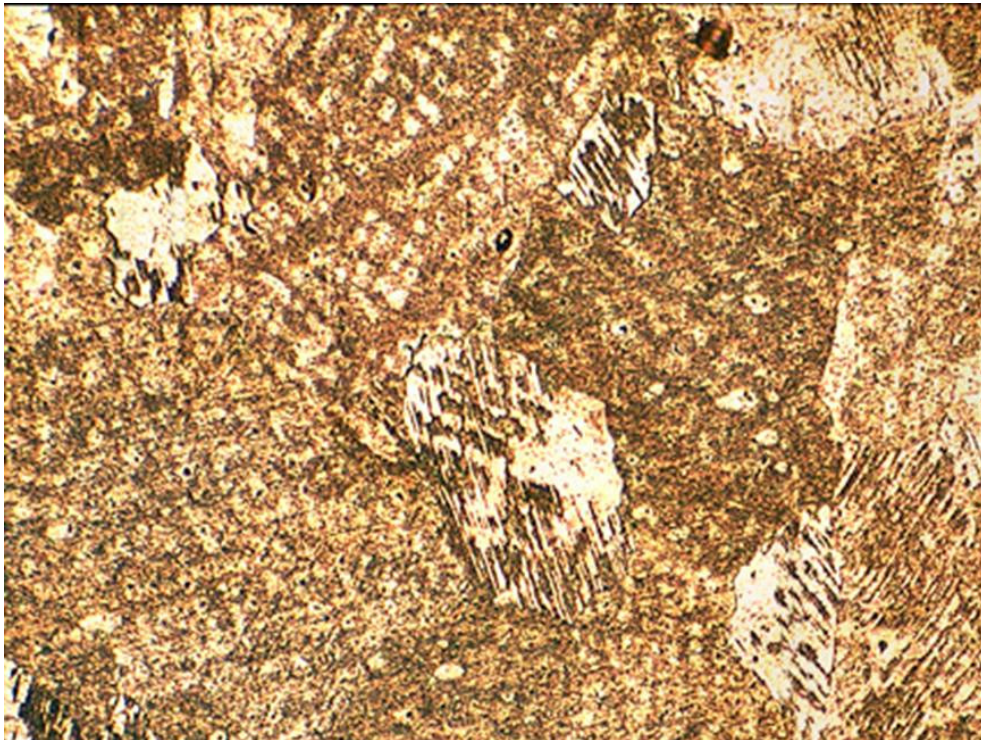
n. centre of the same sample as above, image width 65 μ m

Figure CR3. Cold-rolled 6% Sn bronze, cast in clay /air-cooled at various reductions.

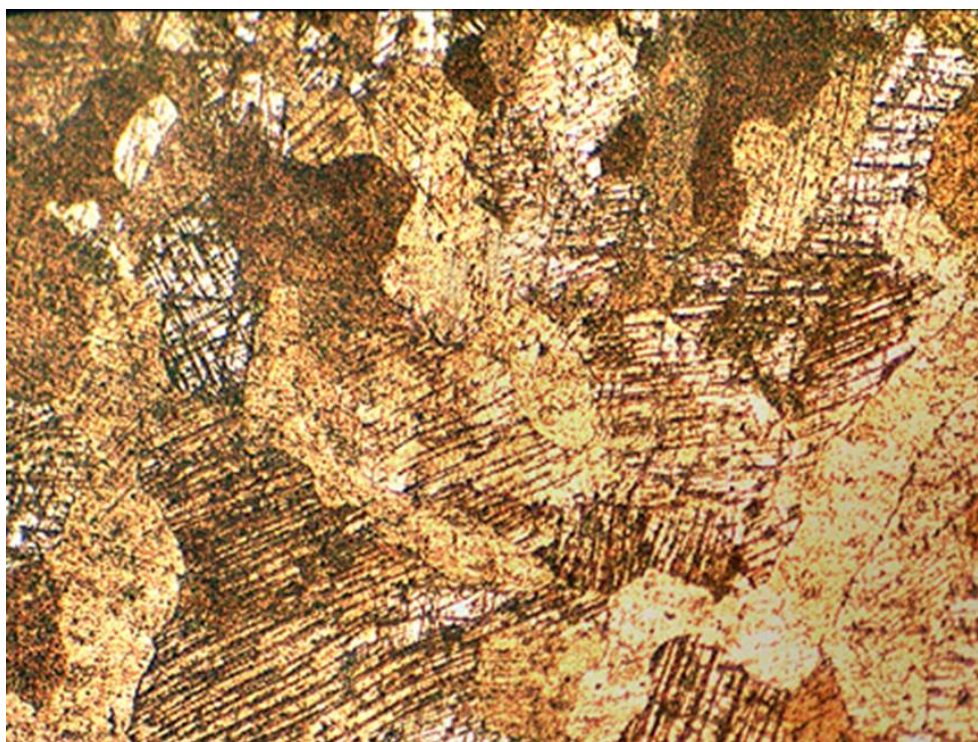
Appendix 5: Colour photomicrographs of the series of cold working and annealing



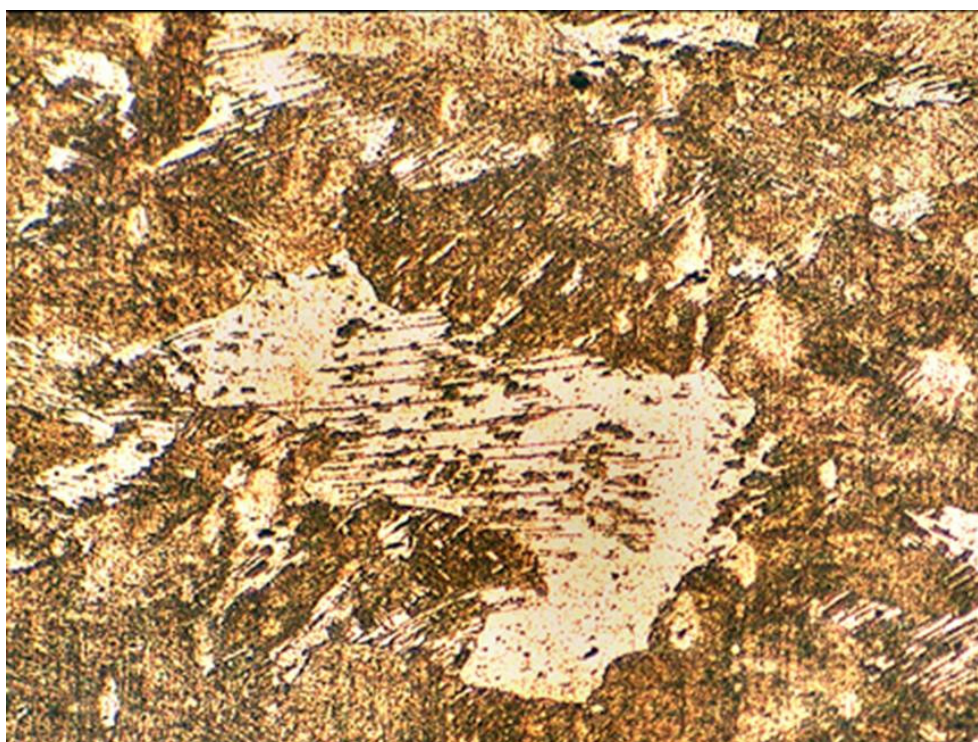
a. surface of 10% reduction, image width 0.65mm



b. centre of 10% reduction, image width 0.65mm



c. surface of 30% reduction, image width 0.65mm



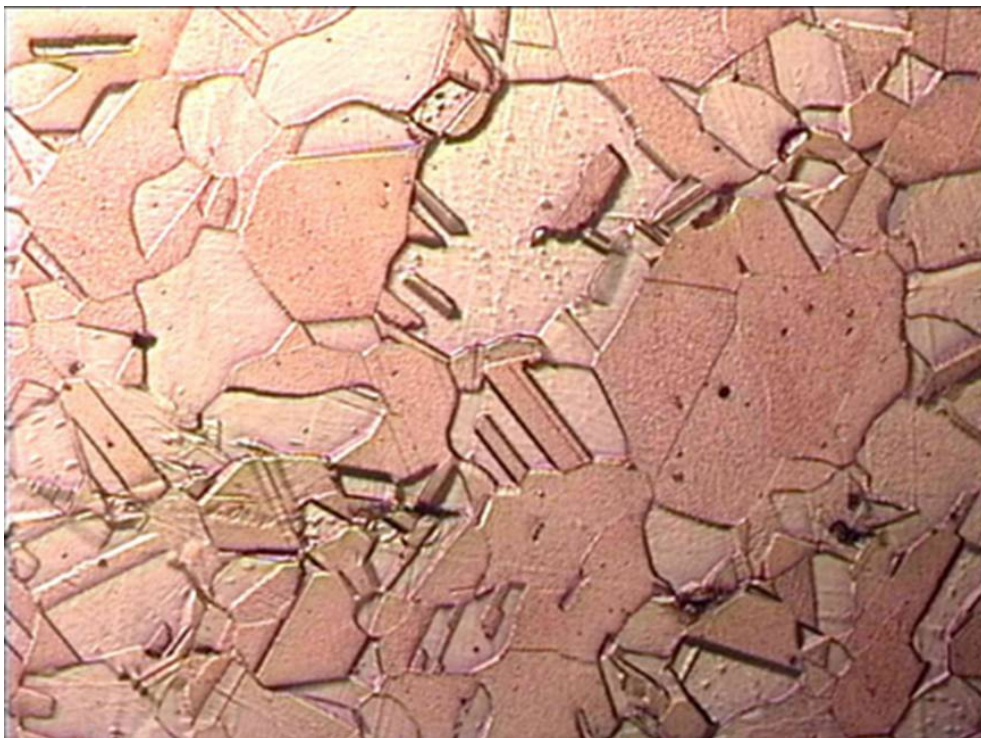
d. centre of 30% reduction, image width 0.65mm

Figure CR4. Cold-rolled 6% Sn bronze, cast in bronze mould /air-cooled at variable reductions.

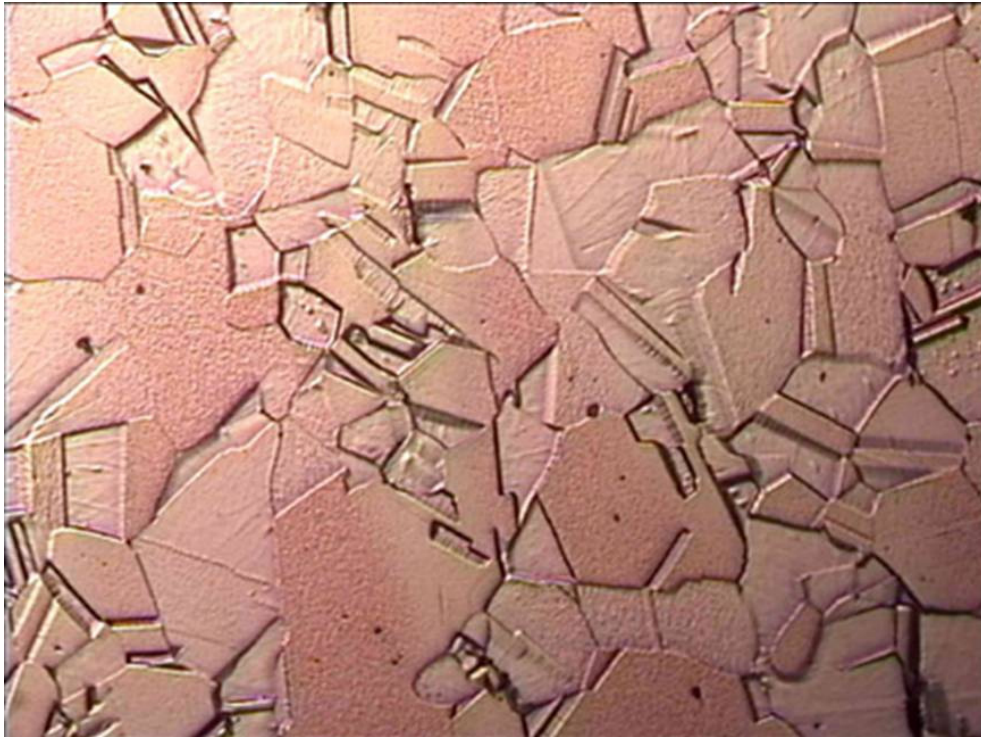
Appendix 5: Colour photomicrographs of the series of cold working and annealing



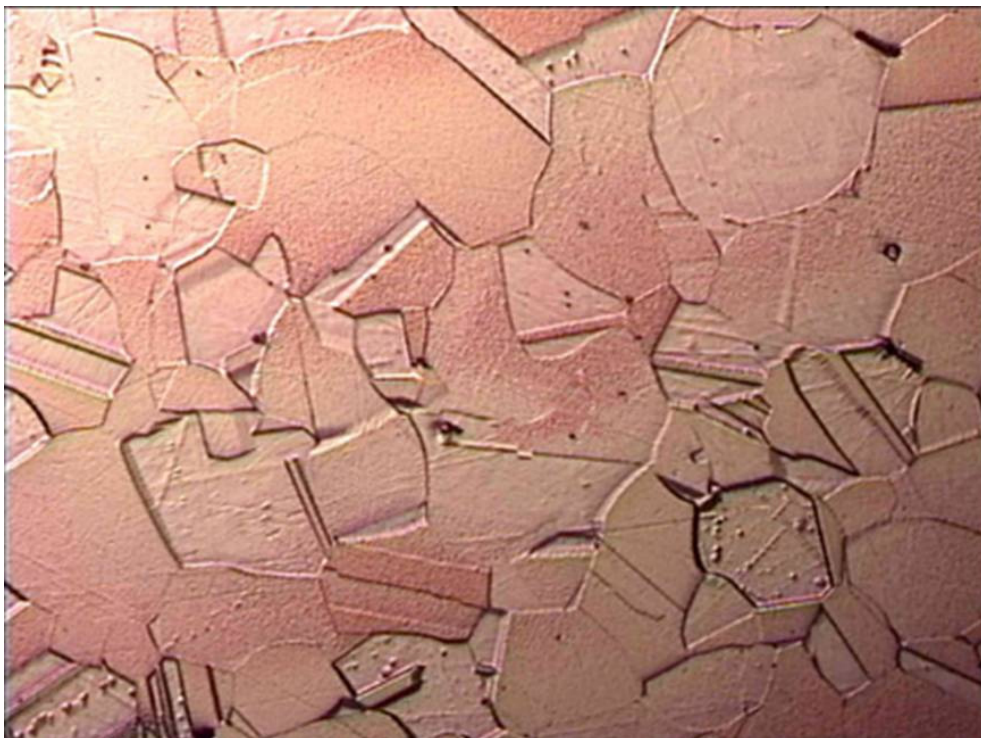
a. surface of sample annealed at 550°C/15minutes, image width 0.13mm



b. centre of sample annealed at 550°C/15 minutes, showing bigger grains than at the surface, image width 0.13mm

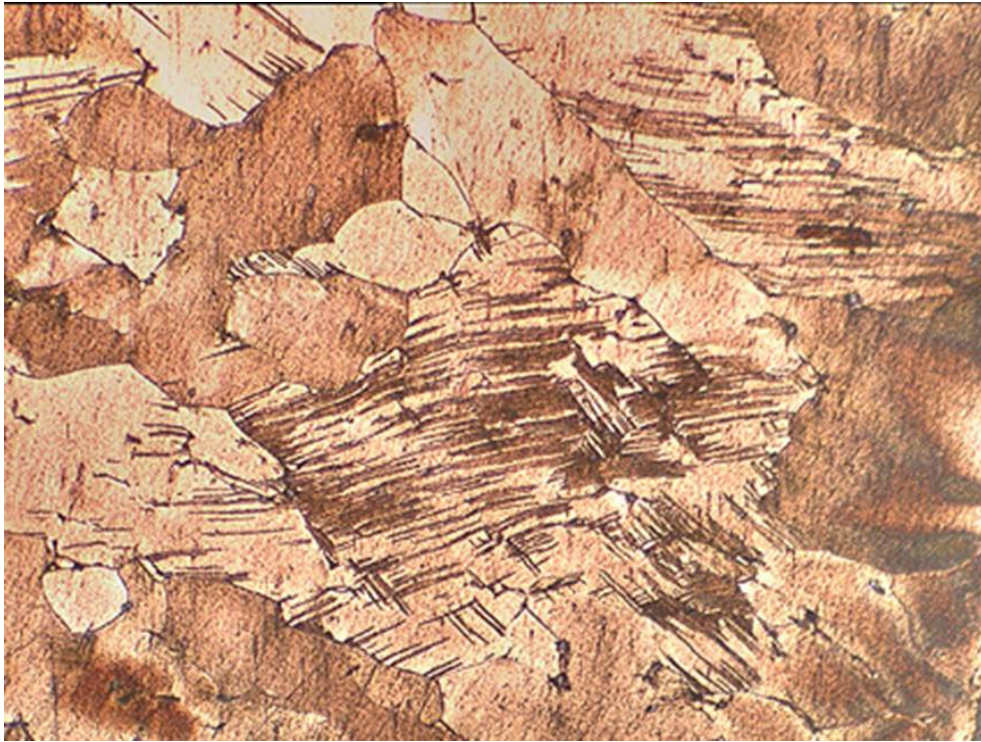


c. centre of sample annealed at 600°C/15 minutes, showing complete recrystallisation. Image width 0.13mm



d. centre of sample annealed at 650°C/15 minutes, showing a complete recrystallisation. Image width 0.13mm

Figure CR5. 6% Sn bronze cast in sand/air-cooled with 40% reductions annealed at three different temperatures

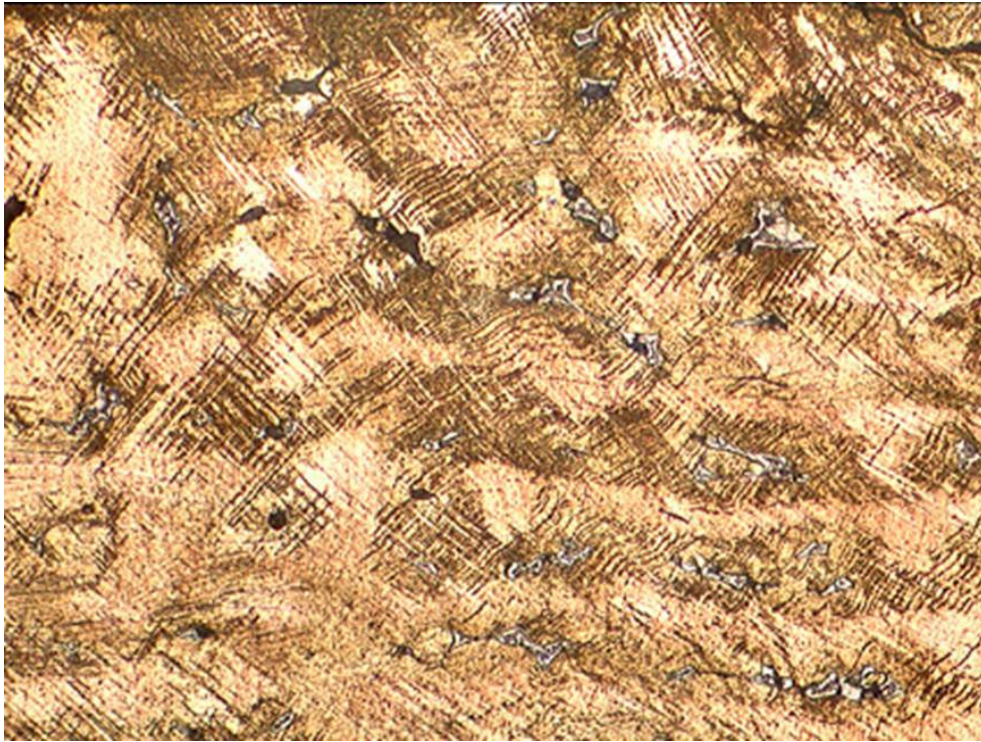


a. 30% reduction followed by annealing at 600°C/15minutes , followed by cold-rolling to a total reduction of 45%, showing the as-cast structure with slip lines. Image width 0.65mm

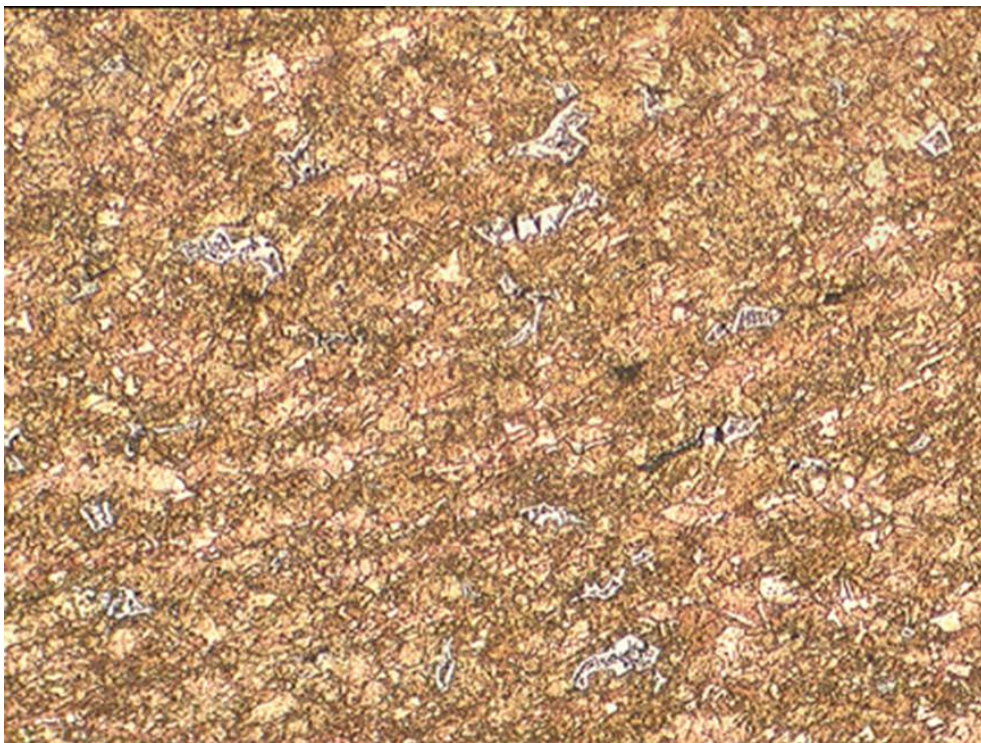


b. the above sample was further cold-rolled to a total reduction of 60% after annealing at 650°C/15minutes, showing an equi-axed structure with annealing twins. Image width 0.13mm

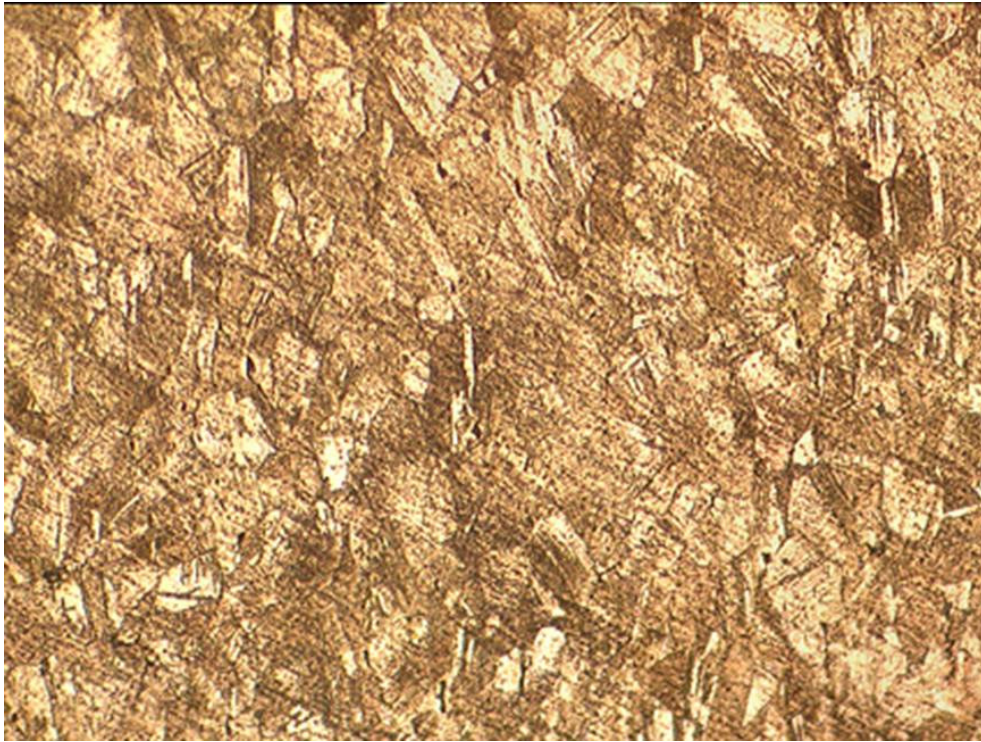
Figure CR6. Cold-rolled and annealed 2% Sn bronze, cast in sand mould /air-cooled at various reductions.



a. 30% reduction, showing slip lines and $\alpha+\delta$ eutectoids. Image width 0.33mm

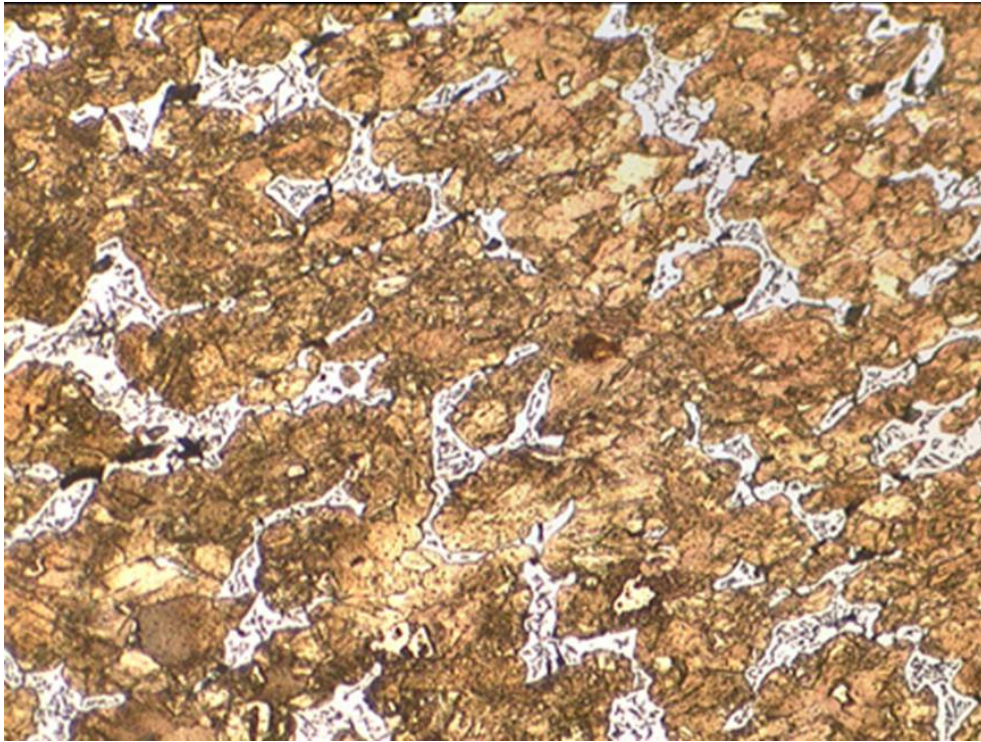


b. the above sample further cold-rolled to a total reduction of 45% after annealing at 600°C/15minutes, showing an incomplete recrystallised structure and remnant $\alpha+\delta$ eutectoids. Image width 0.33mm

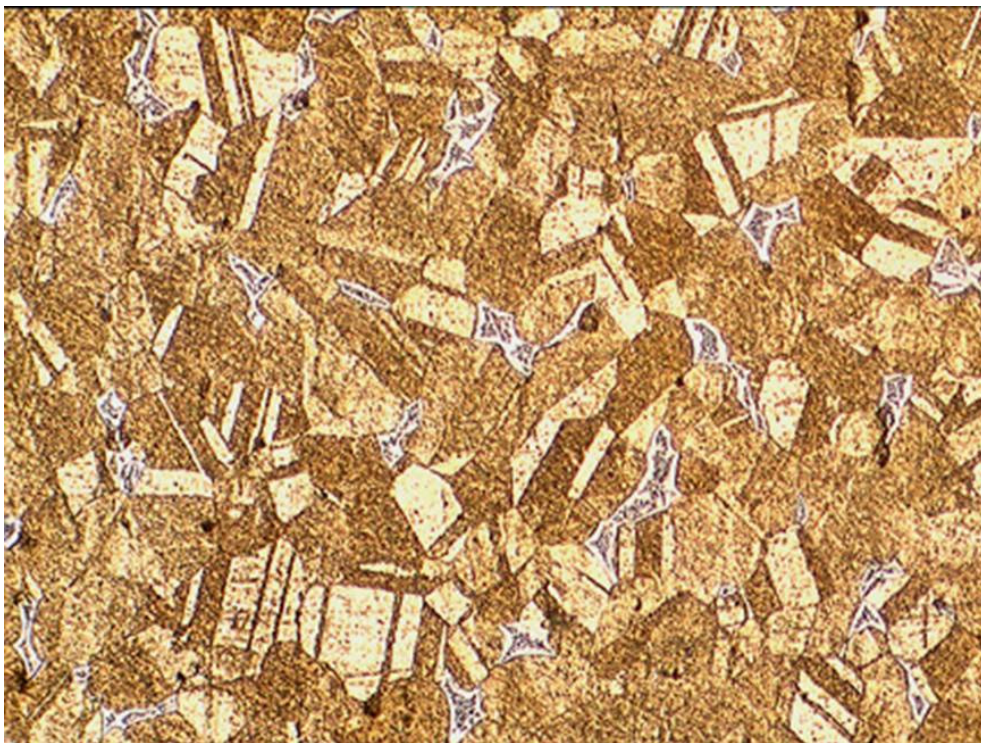


- c. the above sample further cold-rolled to a total reduction of 60% after annealing at 650°C/15minutes, showing a more recrystallised structure than CR7b. Image width 0.33mm

Figure CR7. Cold-rolled and annealed 10% Sb bronze, cast in sand mould /air-cooled at various reductions.



a. 30% reduction followed by annealing at 600°C/15minutes, followed by further cold-rolling to a total reduction of 45%, showing the start of recrystallisation and remnant $\alpha+\delta$ eutectoids. Image width 0.33mm



b. the above sample further cold-rolled to a total reduction of 60% after annealing at 650°C/15minutes, showing more recrystallised structure with annealing twins and less $\alpha+\delta$ eutectoids than above. Image width 0.33mm

Figure CR8. Cold-rolled and annealed 15% Sn bronze, cast in sand mould /air-cooled at various reductions.

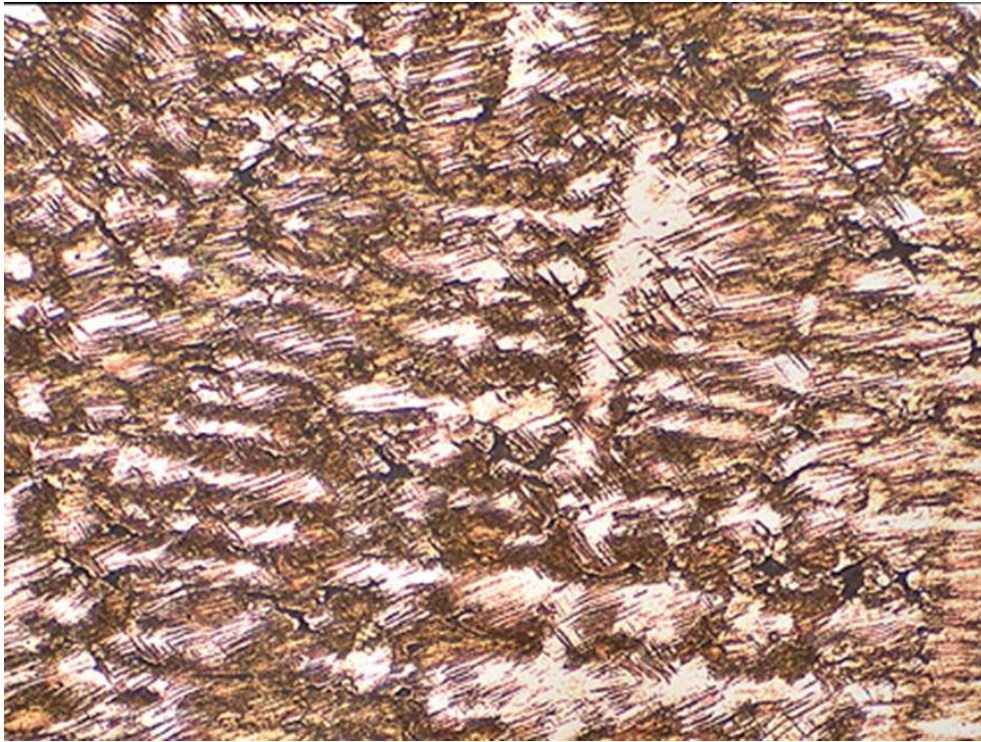


a. 30% reduction followed by annealing at 600°C/15minutes, followed by further cold-rolling to a total reduction of 45%, showing remnant granular structure. Image width 0.33mm

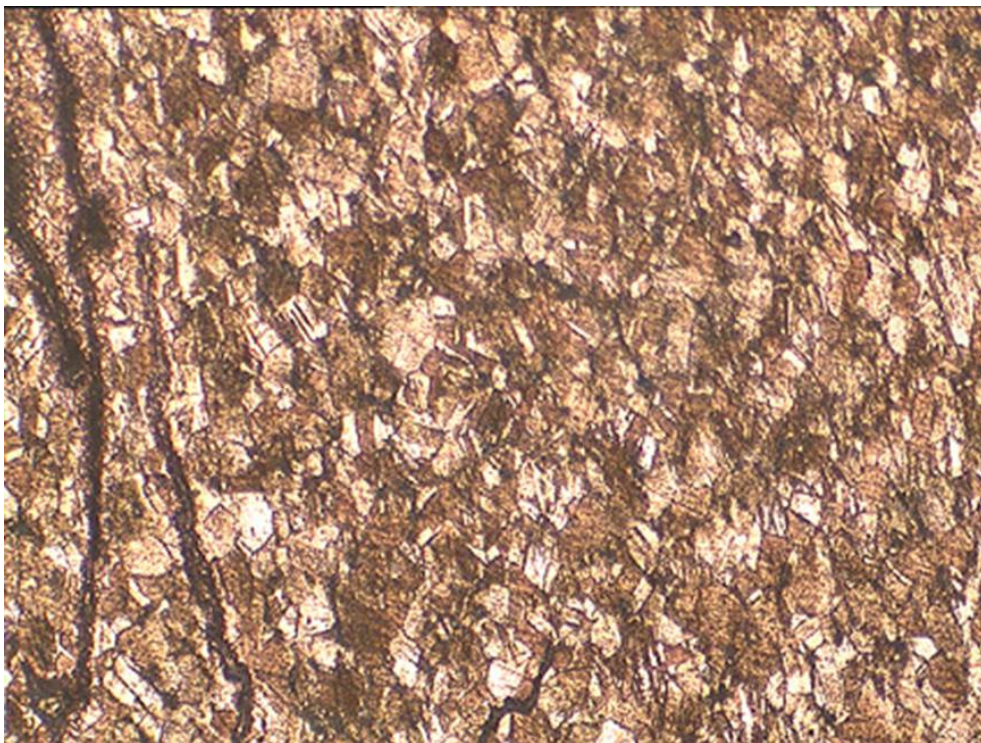


c. the above sample further cold-rolled to a total reduction of 60% after annealing at 650°C/15minutes, showing a recrystallised structure with annealing twins and elongated Pb droplets. Image width 0.33mm

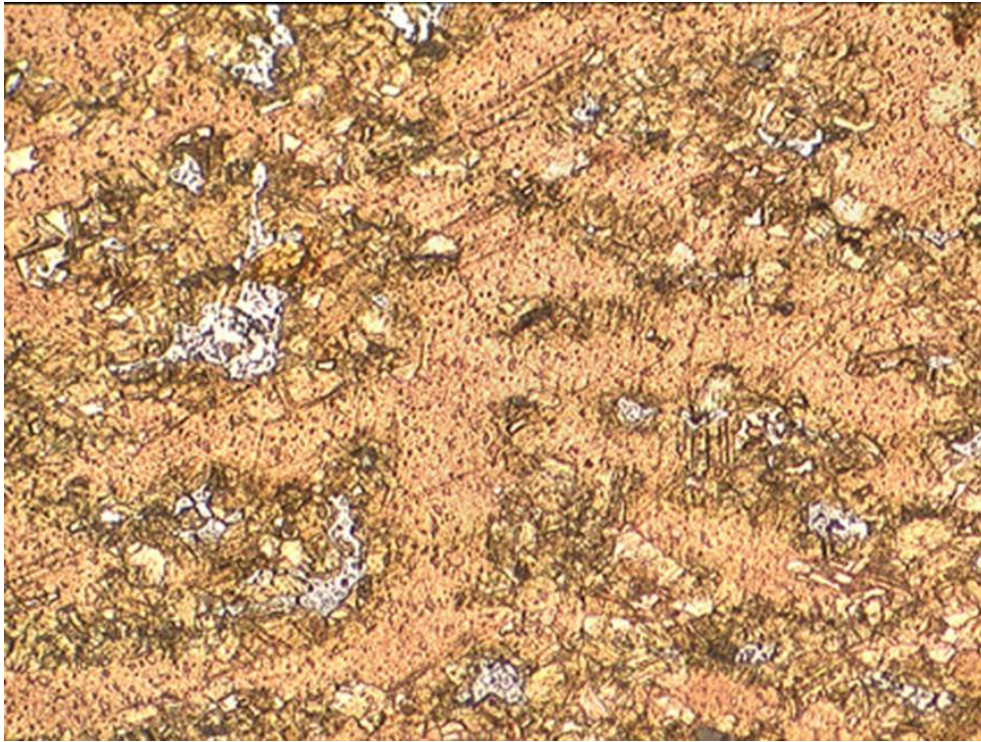
Figure CR9. Cold-rolled and annealed 2% Sn + 6% Pb bronze, cast in sand mould /air-cooled at various reductions.



a. 30% reduction followed by annealing at 600°C/15minutes, followed by further cold-rolling to a total reduction of 45%, showing remnant dendritic structure and slip lines. Image width 0.65mm



b. the above sample further cold-rolled to a total reduction of 60% after annealing at 650°C/15minutes, showing a recrystallised structure with annealing twins and elongated Pb droplets as well as cracks. Image width 0.65mm
Figure CR10. Cold-rolled and annealed 6%Sn + 6%Pb bronze, cast in sand mould /air-cooled at various reductions.



a. 30% reduction followed by annealing at 600°C/15minutes, followed by further cold-rolling to a total reduction of 45%, showing slip lines, remnant dendritic structure and $\alpha+\delta$ eutectoids. Image width 0.33mm



b. the above sample further cold-rolled to a total reduction of 60% after annealing at 650°C/15minutes, showing a recrystallised structure and changed Pb droplets. Image width 0.33mm.

Figure CR11. Cold-rolled and annealed 10%Sn + 2%Pb bronze, cast in sand mould /air-cooled at various reductions.