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Al alloys phases recognition using X-ray transmission

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This project outlines a methodology for analysing aluminium alloys through transmission imaging using an X-ray cone beam and a hyperspectral detector. This approach aims to enhance the aluminium recycling process by improving sorting and effectively controlling phases during re-solidification to reduce the material degradation. The experimental setup includes temperature control to prevent energy bin shifts or image blurring due to thermal expansion movements and a diode to monitor the X-ray tube flux. Samples are prepared with homogeneous thickness and aligned using a rail system for varying magnifications, able to resolve the alloy microstructure on a ˜10um scale. The system is validated by attenuation curves of reference samples, which show the k-edges of the expected elements and the consistency with theory. Nevertheless, the agreement is not complete for absorption effects below 10keV. A neural network classification model was trained on theoretical curves to distinguish between measured alloys. The performances are presented for various equivalent fluxes to determine the required count rate for conducting this process efficiently. The observation of an AlCu(20%wt) alloy reveals its dendritic structure, confirmed through spectral analysis and comparison with EDX information. A method for automatic elemental composition determination is explored to create a labelled dataset and train a neural network. Results are returned in a fraction of a second and this is expected to be the same when increasing the number of elements in the alloy. This comprehensive method demonstrates the potential of transmission imaging and the limitations to be overcome for characterizing aluminium alloys during real-time applications, taking advantage of the benefits introduced by neural networks.

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