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Non-destructive, three-dimensional (3D) characterization of the grain structure in mono-phase polycrystalline materials is an open challenge in material science. Recent advances in synchrotron based X-ray imaging and diffraction techniques offer interesting possibilities for mapping 3D grain shapes and crystallographic orientations for certain categories of polycrystalline materials. Direct visualisation of the three-dimensional grain boundary network or of two-phase (duplex) grain structures by means of absorption and/or phase contrast techniques may be possible, but is restricted to specific material systems. A recent extension of this methodology, termed X-ray diffraction contrast tomography (DCT), combines the principles of X-ray diffraction imaging, three-dimensional X-ray diffraction microscopy (3DXRD) and image reconstruction from projections. DCT provides simultaneous access to 3D grain shape, crystallographic orientation and local attenuation coefficient distribution. The technique applies to the larger range of plastically undeformed, polycrystalline mono-phase materials, provided some conditions on grain size and texture are fulfilled. The straightforward combination with high-resolution microtomography opens interesting new possibilities for the observation of microstructure related damage and deformation mechanisms in these materials.