Status Report of the Target Laboratory at GSI

At the target laboratory at GSI we produce only all-solid targets. We produce targets through resistance heating, thermal evaporation and electron beam gun evaporation from the crucible, boat, basket or liner, magnetron sputtering, cold rolling and mechanical finishing. The thickness range we cover is given by the production method and the material. We cannot produce all well-established materials over the complete thickness range. Often there is a gap in the thickness from one production process to the other.

Self-supporting targets through evaporation are produced over a wide thickness range. We obtain self-supporting carbon thin films from 5 µg/cm² to 100 µg/cm². They are made by resistance heating of a carbon rod and deposited on a betaine-sucrose interlayer. Self-supporting gold-targets from 50 µg/cm² up to 2 mg/cm² are made by thermal evaporation from a tungsten boat on betaine-sucrose, tensides or alkali halides. Self-supporting targets out of Ag, Al, Au, Bi, Cu, Cr, Ge, In, Sn, Pb, Y, Zn are produced by thermal evaporation. Self-supporting targets out of Cr, Fe, Mo, Nb, Ni, Pd, Pt, Ta, Ti, W, Zr are produced by evaporation with the electron beam gun. Self-supporting targets out of Ag, Au, Cd, Co, Cr, Ni, Pt are produced by magnetron sputtering. High melting materials are deposited on annealed copper foils which can be solved by nitric acid or trichloroacetic acid. Depending on the requirements high purity natural or isotopically enriched starting material is applied.

The decision which material is produced with which process, depends on the sublimation or melting temperature, the availability of an appropriate crucible material, the availability of an appropriate solvent for the interlayer and on the price of the material in connection with the reachable yield.

Carbon can be produced very thin and depending on the thickness up to several square centimetres in size. With its low Z it is an ideal backing for materials which cannot be produced self-supporting. On carbon backings a wide variety of elements and compounds can be deposited successfully. Good results were achieved over the last years for high melting compounds to substitute low melting or easily oxidizing metals, on heated carbon backings: PbS for Pb, BiF₃ for Bi, SnO for Sn, NdF₃, UF₄. Beside from UF₄ we only use stable materials. For several experiments isotopically enriched material is needed. Mostly the compound has to be synthesised as only the element can be bought directly.

Self-supporting targets down to 1 µm can be obtained by cold rolling between hardened stainless steel sheets. Nickel, holmium and vanadium can be rolled down to 400 µg/cm². For lead the thinnest we received until now is 3 mg/cm². For Ag, Al, Au, Cd, Co, Cu, Er, Fe, Gd, Hf, Mg, Mo, Nb, Pt, Sc, Sn, Ta, Te, Th, Ti, V, Yt, Y, Zr a thickness of 1 µm depending on the starting materials is feasible. Powder as starting material has to be molten; several foils have to be annealed again and again to gain good results. Here as well, depending on the requirements high purity natural or isotopically enriched stating material is applied.

Massive targets from few millimetres up to several centimetres thickness are cut, lapped, and polished to obtain coplanar faces with an optical quality. Typical materials here are: Ag, C, Cu, Pb, quartz, Sn, Ta, Ti, Zn.