**CLAIMS**

**1.** An apparatus for selecting products on the basis of their composition via X-ray fluorescence spectroscopy, comprising an X-ray source (11) that emits an X-ray beam (XB, XBC) towards a product sample (20), and a particle detector (15) for receiving an X-ray beam (XBR) diffused by said product sample (20) and generating a received signal that can be analysed to determine a chemical composition of said product sample (20) and select a type of product corresponding to said chemical composition of the product sample (20),

said apparatus being characterized in that:

said apparatus comprises

a bottom portion (44) facing said product sample (20) comprising an output window (45) facing the product sample (20), an axis (I) of said X-ray beam (XB) and an observation axis (O) of the detector (15) passing through said output window (45),

a first vacuum chamber (13) located between said output window (45) of the apparatus (10) facing the product sample (20) and said X-ray source (11) on said axis (I) of said X-ray beam (XB), and a second vacuum chamber (14) located between said output window (45) of the apparatus (10) facing the product sample (20) and said detector (15) on said observation axis (O) of the detector (14),

a system (18) of variation of angle (α) between X-ray source (11) and detector (15) configured to rotate the axis (I) of said X-ray beam (XB) and the observation axis (O).

**2.** The apparatus according to Claim 1, characterized in that said apparatus (10) further comprises an optical module (12) with polycapillary lens located downstream of said X-ray source (11), which is configured for focusing said X-ray beam (XB) and is moreover associated in a vacuum-tight way to said first vacuum chamber (13).

**3.** The apparatus according to Claim 1 or Claim 2, characterized in that said apparatus (10) for selecting products on the basis of their composition via X-ray fluorescence

spectroscopy comprises a thermal shield (44) between said first (13) and second (14) vacuum chambers and said product sample (20), said thermal shield (44) comprising said window (45) at said output of the apparatus (20).

**4.** The apparatus according to Claim 1, characterized in that it comprises a mechanical arrangement (16; 33, 34, 35, 36, 13b, 14b) configured for modifying an angle (α) between an axis (I) of said emitted X-ray beam (XB) and an axis of observation (O) of the detector (14) in order to modify a position, in particular the depth (d) and/or the horizontal position (w), of a focus (F) of the X-ray beam (XB, XBC).

**5.** The apparatus according to Claim 4, characterized in that said mechanical arrangement (16; 33, 34, 35, 36, 13b, 14b) comprises a mechanical sub-arrangement (33, 34, 13b) for varying an angle of incidence (θi) calculated between the axis (I) of the beam (XB) and an axis (P) perpendicular to the surface of the product sample (20), and a further mechanical sub-arrangement (35, 36, 14b) for displacing the axis of observation (O) to an angle of observation (θo) with respect to the perpendicular axis (P) in an independent way.

**6.** The apparatus according to any one of the preceding claims, characterized in that it comprises a module (16) for measuring the height of the surface of the product sample (20), in particular an optical interferometer.

**7.** The apparatus according to any one of Claims 2 to 6, characterized in that it comprises a housing (43), which includes at least one bottom portion (44) configured for operating as thermal shield, in particular made of ceramic material, corresponding to said bottom portion (44) facing said product sample (20) comprising an output window (45) facing the product sample (20).

**8.** A method for selecting products on the basis of their composition via X-ray fluorescence spectroscopy that uses an apparatus according to any one of Claims 1 to 7.

**9.** The method according to Claim 8, characterized in:

setting said selection apparatus (10) in one or more control points of a line (50) for producing or conveying products;

given types (C) of product being processed in a given time interval, defining a set (LS) of significant chemical elements designed to recognise said types (C) of product being processed; and acquiring via X-ray fluorescence spectroscopy a measurement signal (Y) of a sample (20) of said product travelling along said production or conveying line (50) and analysing it limitedly to said set of significant chemical elements (LS).

**10.** The method according to Claim 8 or Claim 9, characterized in that said products are metal-matrix products and said line is a steel-production line.

**11.** The method according to Claim 8 or Claim 9, characterized in that it comprises modifying an angle between an axis (I) of said emitted X-ray beam (XB) and an axis of observation (O) of the detector (14) for varying and/or modifying a position, in particular the depth (d) and/or the horizontal position (w), of a focus (F) of the X-ray beam (XB), in particular as a function of the height measured by said module (16) for measuring the height of the surface of the product sample (20), said module (16) being in particular an optical interferometer.