CLAIMS:

1. A system for detecting and identifying at least one predetermined foreign element in a substance, the system comprising:

a measurement device comprising: a radiation source assembly comprising at least one source of X-ray radiation or Gamma-ray radiation, each source of the at least one source being configured to generate X-ray radiation or Gamma-ray radiation having predetermined properties and a predetermined solid angle of radiation emission to excite a portion of the substance located in a region within the predetermined solid angle of radiation emission to cause an X-ray response of the portion of the substance; a radiation detection assembly comprising at least one detector having a solid angle of radiation detection overlapping with the predetermined solid angle of radiation emission, each detector of the at least one detector being configured and operable to detect an X-ray radiation propagating within a solid angle of radiation detection and generate measured data indicative of the X-ray response of the portion of the substance, including a relative displacement between the substance and at least one of the radiation source assembly and the radiation detection assembly along a movement path; the measurement device being configured and operable such that the measured data is indicative of a time variation of the X-ray response of the portion of the substance;

a flow line arrangement comprising a translation assembly configured and operable for translating at least one of the radiation source assembly and the radiation detection assembly with respect to the movement path; and

a control unit configured and operable for a data communication with the radiation detection assembly to receive and analyze the measured data, the control unit comprising a signal processor configured and operable to identify in the measured data a pattern of a signal variation over time indicative of a location of at least one foreign element carrying an X-ray responsive marker in the substance.

2. The system according to claim 1, wherein the movement path passes through a vicinity of an overlap region between the solid angle of radiation detection and the predetermined solid angle of radiation emission.

3. The system according to claim 1, wherein the flow line arrangement further comprises a support platform for supporting the substance and moving the substance with respect to the at least one of the radiation source assembly and the radiation detection assembly.

4. The system according to claim 1, wherein the translation assembly is configured and operable for translating both the radiation source assembly and the radiation detection assembly with respect to the movement path.

5. The system according to claim 4, wherein the translation assembly is configured and operable for simultaneously translating the radiation source assembly and the radiation detection assembly such that the predetermined solid angle of radiation emission and the solid angle of radiation detection are oriented towards two opposite lateral sides of the movement path.

6. The system according to claim 1, wherein the radiation source assembly and the radiation detection assembly are oriented with respect to the movement path such that the predetermined solid angle of radiation emission and the solid angle of radiation detection oppose a direction of a movement of the substance along the movement path, such that when the substance moves through an overlap region a distance between the substance and each of the radiation source assembly and the radiation detection assembly is being reduced.

7. The system according to claim 6, wherein the pattern of the signal variation over time indicative of the location of the at least one foreign element carrying the X-ray responsive marker in the substance is characterized by a non-symmetric characteristic signal peak indicative of the location of the at least one foreign element carrying the X-ray responsive marker in the substance, the non-symmetric characteristic signal peak having a moderate signal intensity rise when the distance between the substance and each of the radiation source assembly and the radiation detection assembly is being reduced, and a sharp signal intensity fall when the location of the at least one foreign element carrying the X-ray responsive marker in the substance exits the overlap region, thereby enabling to accurately identify the location of the at least one foreign element carrying the X-ray responsive marker in the substance along at least one dimension.

8. The system according to claim 7, wherein the signal processor is configured and operable to integrate the measured data indicative of the X-ray response of the portion of the substance being detected over time, while the at least one foreign element is being moved through the overlap region, thereby emphasizing the non-symmetric characteristic signal peak.

9. The system according to claim 1, wherein the movement path is a substantially linear path.

10. The system according to claim 1, wherein the movement path has a curvilinear path having at least one curved portion aligned with a boundary of an overlap region.

11. The system according to claim 1, wherein the radiation source assembly and the radiation detection assembly are accommodated at opposite lateral sides of the movement path, thereby yielding a reduced variation in a detected signal intensity of the X-ray response of the portion of the substance, irrespective of a lateral location of the at least one foreign element carrying the X-ray responsive marker in the substance while in an overlap region.

12. The system according to claim 11, wherein the radiation source assembly and the radiation detection assembly are accommodated at opposite lateral sides of the movement path such that the X-ray radiation or Gamma-ray radiation and the X-ray response of the portion of the substance being detected vary with a distance from the radiation source assembly and the radiation detection assembly.

13. The system according to claim 1, wherein the signal processor is configured and operable to identify the at least one foreign element carrying the X-ray responsive marker in the substance by analyzing the X-ray response of the portion of the substance over a database storing X-ray signatures corresponding to multiple known X-ray responsive markers.

14. The system according to claim 1, wherein the at least one foreign element carrying the X-ray responsive marker in the substance to be identified comprises one or more plastic elements carrying one or more X-ray responsive markers.

15. The system according to claim 14, wherein the signal processor is configured and operable to process the measured data and generate data indicative of a quantity of the one or more plastic elements within at least a portion of the substance.

16. The system according to claim 1, wherein the at least one source of X-ray radiation or Gamma-ray radiation comprises at least two sources of X-ray radiation or Gamma-ray radiation, each of the at least two sources having the predetermined solid angle of radiation emission oriented with respect to the movement path to irradiate a different side surface of the substance, and the solid angle of radiation detection of the at least one detector oriented to detect the X-ray radiation propagating from a top surface of the substance.

17. The system according to claim 1, wherein the at least one detector comprises at least two detectors having solid angles of radiation detection are oriented with respect to the movement path to detect the X-ray radiation propagating from two opposite side surfaces of the substance, and the predetermined solid angle of radiation emission of the at least one source of X-ray radiation or Gamma-ray radiation is oriented to irradiate a top surface of the substance.

18. The system according to claim 1, wherein the radiation source assembly and the radiation detection assembly are accommodated with respect to the movement path such that the predetermined solid angle of radiation emission and the solid angle of radiation detection are oriented towards two different surfaces of the substance.