The same setup and experiment disclosed in germination #4 was repeated with similar results. In the control dish, 84% had sprouted, while in the acoustic dish, 96% had sprouted. The average root sprout length of the acoustic peas was 30% longer than the control peas (3.26 cm vs. 2.49cm). It was confirmed that the acoustic resonant frequency at low power had an augmenting effect on the growth of the peas.

The results of the above five germination tests, shown in Table 3, confirmed that acoustic resonant energy can have both an disruptive and augmenting effect depending on the length of exposure and power intensity of exposure. Also, it was concluded that the tight clamping of the transducer in gemination #1 must have damped and attenuated the power output from the transducer to mimic low power effect.

TABLE 3

#	Frequency	Power Voltage	Rep. Rate msec	Pulse Width µsec	Transducer Position	Sprouting Results % A	C*
1	1.7 MHz	High	10.00	2.0	clamped	100	75
2	1.7 MHz	High	10.00	2.0	clamped	69	79
3	1.7 MHz	High	10.00	19.98	bottom	72	82
4	1.7 MHz	Low	13.00	0.3	bottom	90	84
5	1.7 MHz	Low	13.00	0.3	bottom	96	84

* A and C define the percentage rates of survival and growth of Acoustic (A) and Control (C) peas.

GERMINATION #6

Germination trays were prepared by placing sterile cotton in the bottom of round plastic bowls equipped with acoustic transducers in the bottom. Seventy-five peas (Sugar snap, Lake Valley lot A2B 1997) were placed in each tray and distilled water was added as needed. An acoustic field was delivered to one group of peas for three days using a Matec 1.0 MHz transducer with a repetition rate of 10 msec having a pulse width of 2 μsec. The peas were then transferred to 6 inch diameter tapered black plastic pots, filled with plant growing medium, having bottom openings for water drainage. Three peas were planted in each container.

The peas were grown indoors with a 1000 watt grow-light. The peas grew to maturity and into plants bearing pea pods which were measured and weighed. Table 4 provides information relating to the overall growth pattern of the mature pea plants.

TABLE 4

	Acoustic Exposed Peas	Control Peas
Number of Mature Plants	64	54
Percent Plants	119%	100%
Number of Pods from Mature Plants	307	287
Percent Pods	107%	100%
Average Plant Length	81 inches	80 inches
Weight of Peas	3.7 oz.	3.1 oz.
Percent Weight	119%	100%
Weight per Plant	0.058 oz.	0.057 oz.
Volume of Peas	160 ml	130 ml
Percent Volume	123%	100%

Conclusion - The acoustically treated peas had approximately 20% greater weight and volume of peas. Weight of peas per plant was identical between the two groups. Hence, the acoustic treatment affected crop yield indirectly, by increasing germination. The acoustic treatment during the first three days affected germination only, and did not affect the subsequent growth and crop yield after the acoustic field was discontinued.

GERMINATION #7

DAY 1 Germination trays (2) were prepared as above in germination #6 with 115 peas per tray. Neither tray was equipped with acoustic transducers. In this experiment, peas contained in one of the prepared trays were induced into acoustic resonance by an acousto-EM field which was delivered via exposure in a shielded room using a 20 foot antenna and an E field generator. EM energy at a frequency of 1.7 MHz was applied continuously at a power of 8.5 volts/m. The tray containing the control peas was kept in a second shielded room without exposure to an acousto-EM field.

DAY 3 - 11 of the peas exposed to the acousto-EM field sprouted while only 5 of the control peas sprouted. The acousto-EM exposed peas were almost twice the length of the control peas.

DAY 6 - 45 of the peas exposed to the acousto-EM field had sprouted while only 35 of the control group had sprouted.

DAY 10 - 61 of the peas exposed to the acousto-EM field had sprouted while only 45 of the control group had sprouted. The average length of the leaf sprout on the exposed acousto-EM field group was 3.3 cm while the average length of the control group was only 2.7 cm.

RESULTS: Using acousto-EM energy at the resonant acoustic frequency augmented the germination and growth rate of the peas.

Example 11

Detection and Identification of Inorganic Structures

The methods and systems of the present invention have a wide range of useful applications, such as on-site identification both qualitatively and quantitatively of various types of inorganic matter or structures, recognition of impurities in metal alloys, recognition of armaments and weapons, such as plastic explosives, etc.

Detection and identification can be achieved by applying acoustic energy at a frequency closely matching the resonant frequency of an object or structure thereby inducing acoustic resonance therein for detection of a unique acoustic and/or acousto-EM signature. Using methods known to those skilled in the art, any device capable of generating and transmitting acoustic energy through any medium can be used to generate the resonant acoustic and/or acousto-EM frequencies utilized by this invention including the apparatus disclosed and shown above in Figure 1.

Using methods known to those skilled in the art, any device capable of detecting and analyzing acoustic energy and/or EM energy through any medium can be used to detect the resonant acoustic and/or acousto-EM frequencies utilized by the invention such as disclosed and shown above in Figure 2.

The system shown in Figure 12 gives a schematic overview of the necessary components to be utilized in determining resonant acoustic frequencies of different inorganic materials or structures. Predetermination of the specific frequencies and acoustic and/or acousto-EM signatures will provide a database for later comparisons.

In Figures 35 A & B block diagrams show the apparatus setup wherein resonant acoustic energy can be combined with acousto-EM energy for a spectroscopic method to identify, detect and distinguish similar or dis-similar objects. This can be accomplished by stimulating an object to resonance by the use of acoustic energy, electromagnetic energy or both. When the resonant acoustic frequencies are applied to the sample, acoustic resonance is induced and a unique electromagnetic energy pattern is generated, that being the resonant acousto-EM signature. Mechanisms producing the resonant acousto-EM signature may include, but are not limited to piezoelectricity, acoustoelectricity, magnetoacoustics and/or intrinsic energy dissipation. The resonant acousto-EM signature is a manifestation of electromagnetic properties and/or fields including, but not limited to, direct current, alternating current, magnetic field, electric field, EM radiation, and/or acoustic cyclotron resonance.

Analysis is then performed on the resultant acoustic, electromagnetic or combined energy spectrum produced. The distribution of acoustic and electromagnetic frequencies and/or properties is then characterized to describe a unique acoustic and/or acousto-EM signature of the object.

The present invention may be utilized in security systems such as in airports where concerns regarding the transport of plastic explosives or plastic weapons into airlines terminals and carriers are generating increased security surveillance. Metal detectors are not capable of detecting polymers because in most cases the polymers will not respond to the magnetic fields of the device. Likewise, the other alternatives such as X-rays devices or trained animals are not able to distinguish one polymer from another, and therefore, some explosives can be difficult to detect.

A detection device can be used that will recognize the unique acoustic signature and/or acousto-EM signature which characterizes a particular plastic explosive.

To determine the acoustic resonant frequency of the plastic explosive, the natural frequency of the plastic containing the explosive has to be determined first. The method to determine the resonant frequency which in turn determines the frequency needed to induce acoustic resonance includes the following steps. A sample of the plastic having a known quantity of explosive material is placed between two transducers comprising thin slices of thin film zinc oxide on a sapphire substrate available from Teledyne Electronic Technology. The sample is adhered to the transducers by phenyl salicylate, a coupling medium that acts as an adhesive and also allows the transfer of energy. One of the transducers is connected to a Teledyne Microstrip Matching Network, which is an impedance matching device. The impedance matching device is in turn connected to a Hewlett-Packard Model 6286A power source. The other transducer is also connected to a Teledyne Microstrip Matching Network which in turn is connected to a B & K Precision Model 2625 spectrum analyzer. The acoustic signal, of the plastic test sample, transmitted from the transducer is fed into the positive lead of the spectrum analyzer. The known acoustic signals from the testing fluids, holders, transducer material served as a control and are fed into the negative lead of the spectrum analyzer. Using this setup the control signatures are canceled out and the remaining resonant acoustic signature displayed is from the plastic explosive, yielding a qualitative result and a unique signature.

The power source is activated and a range of voltages is transmitted to the transducer. The electrical signal induces a mechanical strain in the transducer material causing an acoustical energy wave in a specific frequency range corresponding to the voltage that is delivered by the power source. This acoustic wave is transmitted through the plastic sample and received by the second transducer. The electrical output from the transducer is converted into a readable format by the spectrum analyzer. The resonant frequency and in turn the resonant acoustic signature can be determined by this method. By varying the voltage from the power source, the amplitude of the transmitted acoustic wave reacts to the different applied voltages. When the amplitude of the signal reaches a maximum, the plastic sample is in acoustic resonance and the frequency that induces this state substantially corresponds to the resonant frequency. At this point, the resonant acoustic and/or acousto-EM signature can be determined.

Once the resonant acoustic signature of the plastic explosive is determined then a test can be conducted with several different types of plastic, some that contained the explosive and some that do not. Again each sample is placed in the same setup as explained above. The previously determined frequency range to induce acoustic resonance in the sample containing the explosive is administered by the power source using the corresponding voltage. The samples are individually tested and only the samples containing explosives reach