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Microwave Welding of Metals and Non-metals (Thermo-Plastics)

[Joining or welding of two Materials using microwave]

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Abstract:

Welding is the most important manufacturing practice since the evolution of the machine age in human history since the evolution of the iron age in humankind the processing and casting of metals and nonmetals were started and with the evolution of the industrial age or with the invention of welding, the process of manufacturing the complicated design in an efficient time and easiness was possible but traditional welding processes do have disadvantages like weakening of the strength of the material to be welded in terms of structural disturbance on micro as well as a macro level of the structure of the material. The joining of the two materials especially in metals for the formation desired shape for different applications. As global trends focus towards the reduction of hazardous gases like CO_2, SO_2, NO_2 and other environment-polluting hazardous gases, the traditional welding techniques do involve the release of hazardous gases in the environment which results in polluting the environment and ultimately resulting in threatening the life of the planet and human race. Welding is popular in all industries when it comes to joining two materials, especially in metals and other types of welding in joining non-metals. The Microwave welding of two materials (Metals) can be very effective and time-saving in the manufacturing process of various articles and in many other applications involving the joining of two metal surfaces for creating desired products. We can also weld or join nonmetals (Thermo-Plastics), the microwave welding can be effective and time-saving as compared to other types of traditional weldings.

Microwaves can be used to weld or join two materials Metals or Non-Metals (Thermo-Plastics) in very less time and the bonding of the materials is very strong without destroying or creating failures in the materials. The future of welding is Microwave welding as it releases hazardous gases into the environment polluting it and is precise and does not weaken the material's strength or failures in the materials. Microwaves can be utilised for welding processes by converging or concentrating the microwave into a beam through wave guides as microwaves can be converted into beam through wave guides as microwaves get reflected from certain metals which have low bulk resistivities such as brass, copper, silver and aluminium. With the help

of brass tubes of 1.45 cm diameter that can be attached to a punch which has a capillary cavity through which the microwave can be passed and the punch can be pressed over the surface of the material the microwave beam can be concentrated on point of the material and with a hydraulic mechanism which will direct the welding and proceeds with the joining of two metals or non-metals in a very efficient manner.

Microwave on hitting the surface of Metals or Non-Metals (Thermo-Plastics) excites the atoms of the materials in a very vigorous way resulting in the rise of the temperature of the material, the two surfaces on reaching the melting temperature when pressed with a punch attached to it will join the two surface without disturbing or creating failure in the material. We'll be using the Microwave with around 2-6 Ghz of frequency at this intensity or frequency of the microwave the temperature can rise upto even 2500^0 to 3000^0 C which will quickly weld or join the two materials the size of the welding can be monitored through adjustable nozzles of the punch and the temperature can be controlled through the electronic circuits in the Magnetron which is the key part produces the microwave.

Microwave welding has a great advantage over other welding procedures as it does not release pollutants into the environment and is also very fast and precise over other techniques. It creates a very smooth weld surface and does not weaken the strength of the materials. And it does not have a heating conduction problem which reduces the overheating problem in the workpiece and joins the two surfaces of the material strongly without creating failure in the material which can weaken the strength of the material.

Microwave welding procedures can be applied to both wires as well as powder welding procedures in additive manufacturing techniques in making metal objects very accurately and time efficiently. The above-mentioned technique can be made as a handy tool in the welding field to be used in a very versatile manner anywhere where the joining or the welding of the two materials is needed.

Microwave welding or the joining of materials can even be used in an atmosphere-less environment and in outer space, this technique in welding can be very effective in spacecraft welding or in the making of mechanical structures in outer space where welding is needed for the tough and strong joints of two materials. Microwave welding is effective in every environment on the ground, underwater or in outer space.

Currently, for doing underwater welding processes for repairing work or underwater construction Hyperbaric welding is used which takes place high pressurise enclosure or underwater where the pressure is high or in a wet condition and dry conditions high pressurize enclosure is used, which makes this technique very dangerous and risky for human life and vulnerable for underwater accidents and industrial accidents and also

very costly so, with microwave welding, we can easily join two surfaces or materials without any risk involved in it and the welding is also very strong as compared to the current technique involved in the welding.

For Outerspace welding for the repair and construction of spacecraft and satellites welding process called Cold Welding is used this technique differs from traditional welding as it does not involve the heat to melt the material to join each other as it is occurring in the vacuum, but it too has disadvantages which like it can be only performed on soft metals and it also causes the mechanical problem, but microwave welding can be applied on hard metals as well and also on dissimilar materials also, the hart metal ships and satellite can also be made with technique, so ultimately the microwave welding is the future of the welding process.

Now microwave welding requires a strong microwave of high frequency ranging from 6-35 Ghz for the welding of different types of metals and non-metals, to produce such high-intensity microwave we'll build or connect many magnetrons in a series or make a battery of magnetrons and concentrate the beam of the microwave form through waveguides at a single point or connect all the waveguides emerging from the all the magnetrons to a single cone connected to a punch which has a capillary cavity so that the microwave concentrating on a point can pass through it and it can proceed the welding process of two materials.

Microwave melts the material in a very vigorous and precise way by converting the electromagnetic energy into heat energy as this is also known as the dielectric phenomenon of the material as the microwave penetrates the material the electromagnetic energy I absorbed by the material and then the electromagnetic energy is converted into heating of the material very vigorously this phenomenon of the microwave can only happen in the absorbing materials, not in transparent or reflecting materials which do not absorb the microwave. At the molecular or atomic level when the microwave penetrates the material, the electromagnetic energy is absorbed by the atoms they start vibrating in a very vigorous way because of which the electromagnetic energy is converted into heat energy, hence the heating of the material is very fast when treated with the microwave and when the material is heated upto its semi-liquid state at that time when the minute pressure is applied at point the two materials will form an adhesion and join together and because of this phenomenon, the bonding of two material is possible in a very neat and clean way with a very strong bonding of the two materials whether metals or non-metals (thermo-plastics).

The Advantages of the Microwave Welding are:

Microwave welding has very vast advantages over other traditional welding techniques, the very prime advantage of microwave welding is that it does not weaken the mechanical strength of the material as the other welding process creates crests and other deformations on the surface of the materials which therefore weakens the mechanical strength of the material hence affects the overall strength of the material, so this microwave welding doesn't create any failure in the material.

The welding surface of the join of the two materials is very precise and smooth as said earlier it does not create any deformation on the surface of the material so the welding surface is very precise and smooth. This technique is also very time-saving as compared to other traditional welding techniques.

The bonding or the joint of the two surfaces of the material is very strong as compared to other welding techniques, as the other welding processes create heating for the formation of a semi-liquid state for joining by heating conduction method which takes time as well as the adhesion of the two surfaces is incomplete at some point of the join which in turns weakens the joint, hence the microwave welding it creates the heating effect for the semi-liquid state for joining by creating the vigorous vibration inside the atomics level (converting the electromagnetic energy into the heat energy), this creates the equal and localised heating or melting of the material for joining of the two material, hence creates the stronger bond than the other welding methods.

Application of the Microwave Welding:

Microwave welding has a range of applications as it can be used in dry conditions, and wet conditions i.e., underwater welding In outer space welding as well, microwave welding can be used to make ships or structures underwater as well as in outer space. Microwave welding is precise and time effective as well as the strongest joint over all other welding processes. This welding technique can be used in industries for creating metal products and for making automobiles and Aerospace.