Heating

Infrared rays are not hot.
Contrary to the mistaken belief of many people, the infrared rays emitted by objects such as stoves are not hot of themselves.
So, why do they feel warm?
The answer to that question is closely related to the nature of light.

Heating by radiation with infrared

Heat is transmitted in three ways. The first is by conduction, which requires direct contact, the second is by convection, in which heat is transmitted by gradually heating a medium such as air, and the third is radiative heating, in which objects are heated by absorbing energy from radiation.

Since infrared transfers heat by radiation, direct contact is not required and thus there are no concerns about contamination. Since radiative heat is more easily transmitted deep into matter, the surface and interior are more easily heated than with the other types of heat transfer. Further, the lack of need for an intermediate medium means that radiative heating can be used even in a vacuum. Also, by changing the output level, it is easy to control heating stably over any range from room temperature to 1,000 degrees Celsius.

Because of these characteristics, infrared is used in heat processing systems in a wide range of industries, and the source on which these systems rely for infrared radiation is the halogen lamp.

Heating with flash lamps in the range from ultraviolet to visible light

Infrared is not the only type of light that can be used for heating. Flash lamps that emit radiation in the region from infrared to visible light are also used as light sources for heating applications. Emitting light by the same principle as the strobe lights used with cameras, high-power flash lamps are used in combination with high capacity condensers to generate a flash of light which, during the time it lasts, can contain the equivalent of 10 to 20 households' energy consumption (30 kilowatts).

The technology in which flash lamps are employed is one related to semiconductor manufacturing called "flash lamp annealing." In this process, several dozen flash lamps are used to instantaneously raise the temperature of a thin zone at the surface of silicon wafers to 1000 degrees Celsius in just 0.001 second. Viewed from another perspective, the short flash duration means that just a 0.001-second deviation in the timing of flashes will result in large temperature differences at the wafer, making uniform heat processing impossible. Such precise flash timing, the power technology required to control the depth of heating, and the optical technology required to apply this process over large surfaces are an area in which Ushio excels.

● **Main areas of infrared application**

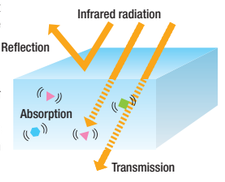
Electronics	Heating and deposition of semiconductor and liquid crystal substrates
Office automation equipment	Fixing print and images on paper
Food processing	Cooking, drying, and temperature maintenance
Forming plastics	Changing the form of plastics using heat application (such as forming plastic bottles)
Heating	Infrared heaters, Japanese kotatsu tables
New material research	New material research involving ultra-high temperatures to dissolve materials

Halogen heater lamps
Halogen heater lamps are also used in semiconductor substrate heating systems.

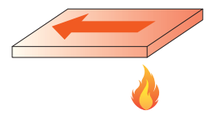
Flash lamp
Heating by up to 1,000 degrees Celsius in just 0.001 second.

"Heating with light" The Mechanism

Radiation
Infrared light is not hot per se, but heats by stimulating vibration of the molecules making up matter.
This results in heat.
① Irradiation of matter with infrared.
② Light energy absorbed by matter stimulates vibration of molecules.
③ Vibration increases collisions between molecules, resulting in heat.



Conduction
The phenomenon by which heat transfers from a region with higher temperature in an object to a region with lower temperature.



Convection
The movement of a warmer volume of air or water which causes warming of the entire volume.