directly proportionate to the amount of material required to fabricate the carbon nanotubes.

BRIEF DESCRIPTION

In one aspect, a chemical vapor deposition (CVD) system for forming carbon nanotubes from solid or liquid feedstock is provided. The system includes a reactor including a housing that includes an inlet and at least one outlet. The housing defines an interior configured to receive the solid or liquid feedstock, and the interior is sized to receive a predetermined amount of inert gas. The CVD system further includes a first stop valve coupled in flow communication with the inlet and a second stop valve coupled in flow communication with the at least one outlet. The first stop valve and the second stop valve are configured to seal the inlet and the at least one outlet for forming a static environment in the interior when reacting the solid or liquid feedstock. A heater is configured to heat the interior to a selected temperature, the interior having the static environment, for vaporizing the solid or liquid feedstock. A circulating device is coupled within the interior. The circulating device is configured to mix the inert gas with the vaporized feedstock The CVD system further includes a controller coupled in communication with the first stop valve, the second stop valve, the circulating device, and the heater. The controller is configured to selectively actuate the first stop valve, the second stop valve, the circulating device, and the heater for controlling operation of the chemical vapor deposition system.

In another aspect, a reactor for forming carbon nanotubes from solid or liquid feedstock is provided. The reactor includes a housing that includes an interior configured to receive the solid or liquid feedstock and sized to receive a predetermined amount of inert gas, an inlet configured to receive the inlet gas, and at least one outlet. The inlet and the at least one outlet are sealable for forming a static environment in the interior when reacting the solid or liquid feedstock. The reactor further includes a heater configured to heat the interior to a selected temperature, the interior having the static environment, for vaporizing the solid or liquid feedstock. A circulating device is coupled within the interior. The circulating device is configured to mix the inert gas with the vaporized feedstock. The reactor also includes a door configured to provide access to the interior.

In yet another aspect, a method of forming carbon nanotubes from solid or liquid feedstock within a reactor is provided. The method includes filling the reactor with a predetermined amount of inert gas, sealing the reactor such that a static environment is formed within the reactor, heating the reactor having the static environment to a selected temperature such that the solid or liquid feedstock is vaporized, thereby forming vaporized feedstock, and circulating the vaporized feedstock throughout the reactor such that the vaporized feedstock mixes with the inert gas.

BRIEF DESCRIPTION OF THE DRAWINGS

WHAT IS CLAIMED IS:

1. A chemical vapor deposition (CVD) system for forming carbon nanotubes from solid or liquid feedstock, said system comprising:

a reactor comprising:

a housing that comprises an inlet and at least one outlet, said housing defining an interior configured to receive the solid or liquid feedstock, said interior sized to receive a predetermined amount of inert gas;

a first stop valve coupled in flow communication with said inlet;

a second stop valve coupled in flow communication with said at least one outlet, wherein said first stop valve and said second stop valve are configured to seal said inlet and said at least one outlet for forming a static environment in said interior when reacting the solid or liquid feedstock;

a heater configured to heat said interior to a selected temperature, the interior having the static environment, for vaporizing the solid or liquid feedstock; and

a circulating device coupled within said interior, said circulating device configured to mix the inert gas with the vaporized feedstock; and

a controller coupled in communication with said first stop valve, said second stop valve, said circulating device, and said heater, said controller configured to selectively actuate said first stop valve, said second stop valve, said circulating device, and said heater for controlling operation of the chemical vapor deposition system.

2. The system in accordance with Claim 1, wherein said reactor further comprises a door configured to provide access to said interior.

3. The system in accordance with Claim 1 or 2, further comprising a vacuum pump coupled in communication with said at least one outlet, said vacuum pump configured to reduce a pressure within said interior when sealed.

4. The system in accordance with any one of the preceding claims further comprising a feedstock holder positioned within said interior, said feedstock holder configured to receive the solid or liquid feedstock.

5. The system in accordance with Claim 4, wherein said feedstock holder comprises:

a mounting base coupled within said interior; and

a removable receptacle selectively coupled to said mounting base, said removable receptacle configured to receive the solid or liquid feedstock.

6. The system in accordance with Claim 4 or 5 further comprising an electrical discharge device coupled to said feedstock holder, said electrical discharge device comprising a pair of electrodes positioned for forming an electrical discharge between said pair of electrodes to facilitate vaporization of the solid or liquid feedstock.

7. The system in accordance with any one of the preceding claims wherein said reactor further comprises a second outlet and a catalytic converter coupled in communication with said second outlet, said catalytic converter configured to receive a stream of a neutralized gas from within said interior.

8. A reactor for forming carbon nanotubes from solid or liquid feedstock, said reactor comprising:

a housing that comprises an interior configured to receive the solid or liquid feedstock, said interior sized to receive a predetermined amount of inert gas;

an inlet configured to receive the inert gas;

at least one outlet, wherein said inlet and said at least one outlet are sealable for forming a static environment in said interior when reacting the solid or liquid feedstock;

a heater configured to heat said interior to a selected temperature, the interior having the static environment, for vaporizing the solid or liquid feedstock;

a circulating device coupled within said interior, said circulating device configured to mix the inert gas with the vaporized feedstock; and

a door configured to provide access to said interior.

9. The reactor in accordance with Claim 8, further comprising a feedstock holder positioned within said interior, said feedstock holder configured to receive the solid or liquid feedstock.

10. The reactor in accordance with Claim 9, wherein said feedstock holder comprises:

a mounting base coupled within said interior; and

a removable receptacle selectively coupled to said mounting base, said removable receptacle configured to receive the solid or liquid feedstock.

11. The reactor in accordance with Claim 11 or 12 further comprising an electrical discharge device coupled to said feedstock holder, said electrical discharge device comprising a pair of electrodes positioned for forming an electrical discharge between said pair of electrodes to facilitate vaporization of the solid or liquid feedstock.

12. A method of forming carbon nanotubes from solid or liquid feedstock within a reactor, said method comprising:

filling the reactor with a predetermined amount of inert gas;

sealing the reactor such that a static environment is formed within the reactor;

heating the reactor having the static environment to a selected temperature such that the solid or liquid feedstock is vaporized, thereby forming vaporized feedstock; and

circulating the vaporized feedstock throughout the reactor such that the vaporized feedstock mixes with the inert gas.

13. The method in accordance with Claim 12, wherein circulating the vaporized feedstock comprises actuating at least one circulating device when the temperature within the reactor is greater than a predetermined threshold.

14. The method in accordance with any Claim 12 or 13, further comprising forming an electrical discharge across a pair of electrodes positioned such that the electrical discharge facilitates vaporization of the solid or liquid feedstock.

15. The method in accordance with any one of claims 12 to 14, further comprising channeling a stream of neutralizing gas into the reactor after

the carbon nanotubes have been formed, wherein the neutralizing gas neutralizes unreacted hydrocarbons of the vaporized feedstock.

16. The method in accordance with any one of claims 12 to 15, wherein heating the reactor comprises heating the reactor to the temperature defined within a range between 800°C and 900°C.

17. The method in accordance with any one of claims 12 to 16, wherein filling the reactor with a predetermined amount of inert gas comprises:

reducing a pressure within the reactor to a predetermined pressure; and

filling the reactor with the inert gas when a pressure within the reactor reaches the predetermined pressure.