resin cures exothermically. During curing of the resin, heat is conducted away from the portion of the composite preform into the heat sink. The portion of the composite preform includes an identified region of local overheating caused by said resin curing exothermically.

In certain embodiments, the heat sink is a passive heat sink formed of an endothermic material. The passive heat sink may comprise a thermoplastic patch. The patch melts during curing of the resin, absorbing heat during melting of the patch.

In alternative embodiments, the heat sink is an active heat sink. The active heat sink may comprise a thermoelectric cooling device. The thermoelectric cooling device is operated during curing of the resin to conduct heat away from the portion of the composite preform.

In typical embodiments, the method further comprises locating the lower surface of the composite preform on an upper tool surface of a tool. A first vacuum bagging film is placed over the composite preform and sealed relative to the tool surface to define a sealed first cavity between the first vacuum bagging film and the tool surface. The composite preform is located in the first cavity. At least partial vacuum pressure is applied to the first cavity during curing of the resin. The heat sink is located above the first vacuum bagging film in proximity to the upper surface of the composite preform.

In certain embodiments, the method further comprises placing a second vacuum bagging film over the first vacuum bagging film and heat sink and sealing the second vacuum bagging film relative to the tool surface to define a second cavity between the first and second vacuum bagging films. At least partial vacuum pressure is applied to the second cavity during curing of the resin. The heat sink is located in the second cavity.

The composite preform may have a non-uniform thickness measured between the upper and lower surfaces, in which case the portion of the composite preform may have a thickness greater than an average thickness of the composite preform.

In certain embodiments, the method may further comprise infusing the resin into the composite preform prior to curing of the resin.

In alternative embodiments, the composite preform may comprise a plurality of plies of prepreg composite material. In such a configuration, the resin is pre-impregnated in the prepreg composite material.

According to a second aspect, the present disclosure provides a system for fabricating a composite structure. The system includes a composite preform having an upper surface and an opposing lower surface. The upper and lower surfaces each define a preform major surface. The system further includes an exothermically curing resin, either to be infused into the composite

preform, or pre-impregnated in the composite preform (when in the form of a prepreg composite material). A heat sink is located in proximity to one of the preform major surfaces so as to extend across only a portion of the composite preform. The heat sink thus does not extend across the entire preform major surface. The portion of the composite preform includes an identified region of local overheating caused by said resin curing exothermically. A heat source is provided for heating the composite preform to cure the resin.

In certain embodiments, the heat sink is a passive heat sink formed of an endothermic material. The passive heat sink may comprise a thermoplastic patch. The thermoplastic patch has a melting temperature less than an exotherm peak temperature of the resin.

In alternative embodiments, the heat sink is an active heat sink. The heat sink may comprise a thermoelectric cooling device.

In typical embodiments, the system further comprises a tool having an upper tool surface. The lower surface of the composite preform is located on the tool surface. A first vacuum bagging film extends over the composite preform and is sealed relative to the tool surface to define a first cavity between the first vacuum bagging film and the tool surface. The composite preform is located in the first cavity. A vacuum source communicates with the first cavity. The heat sink is located above the first vacuum bagging film in proximity to the upper surface of the composite preform.

In certain embodiments, the system further comprises a second vacuum bagging film extending over the first vacuum bagging film and the heat sink. The second vacuum bagging film is sealed relative to the tool surface to define a second cavity between the first and second vacuum bagging films. The vacuum source communicates with the second cavity and the heat sink is located in the second cavity.

In certain embodiments, the composite preform has a non-uniform thickness measured between the upper and lower surfaces. The portion of the composite preform may have a thickness greater than an average thickness of the composite preform.

In certain embodiments, the resin is to be infused into the composite preform.

In alternative embodiments, the composite preform comprises a plurality of plies of prepreg composite material containing the resin.

The features described above may be implemented independently in various embodiments of the present disclosure or may be combined in the other embodiments as will be appreciated by a person skilled in the art.

Drawings

CLAIMS

1. A method of fabricating a composite structure, said method comprising:

providing a composite preform having an upper surface and an opposing lower surface, said upper and lower surfaces each defining a preform major surface;

locating a heat sink in proximity to one of said preform major surfaces so as to extend across only a portion of said composite preform;

curing a resin in said composite preform to form the composite structure, said resin curing exothermically; and

during curing of said resin, conducting heat away from said portion of said composite preform into said heat sink,

wherein said portion of said composite preform comprises an identified region of local overheating caused by said resin curing exothermically.

2. The method of claim 1 wherein locating said heat sink comprises locating a passive heat sink formed of an endothermic material.

3. The method of claim 2 wherein locating said passive heat sink comprises locating a thermoplastic patch, said method further comprising melting said patch during curing of said resin, said patch absorbing said heat during melting of said patch.

4. The method of claim 1 wherein locating said heat sink comprises locating an active heat sink.

5. The method of claim 4 wherein locating said active heat sink comprises locating a thermoelectric cooling device, said method further comprising operating said thermoelectric cooling device during curing of said resin to conduct heat away from said portion.

6. The method of any one of claims 1 to 5 further comprising:

locating said lower surface of said composite preform on an upper tool surface of a tool; and

placing a first vacuum bagging film over said composite preform and sealing said first vacuum bagging film relative to said tool surface to define a sealed first cavity between said first vacuum bagging film and said tool surface, said composite preform being located in said first cavity; and

applying at least partial vacuum pressure to said first cavity during curing of said resin;

wherein said heat sink is located above said first vacuum bagging film in proximity to said upper surface of said composite preform.

7. The method of claim 6, further comprising:

placing a second vacuum bagging film over said first vacuum bagging film and said heat sink and sealing said second vacuum bagging film relative to said tool surface to define a second cavity between said first and second vacuum bagging films; and

applying at least partial vacuum pressure to said second cavity during curing of said resin;

wherein said heat sink is located in said second cavity.

8. The method of any one of claims 1 to 7 wherein providing said composite preform comprises providing a composite preform with a non-uniform thickness measured between said upper and lower surfaces, said portion of said composite preform having a thickness greater than an average thickness of said composite preform.

9. The method of any one of claims 1 to 8, further comprising infusing said resin into said composite preform prior to curing said resin.

10. The method of any one of claims 1 to 8, wherein providing said composite preform comprises providing a composite preform comprising a plurality of plies of prepreg composite material, said resin being pre-impregnated in said prepreg composite material.

11. A system for fabricating a composite structure, said system comprising:

a composite preform having an upper surface and an opposing lower surface, said upper and lower surfaces each defining a preform major surface;

an exothermically curing resin to be infused into said composite preform, or pre-impregnated in said composite preform;

a heat sink located in proximity to one of said preform major surfaces so as to extend across only a portion of said composite preform; and

a heat source for heating said composite preform to cure said resin cure,

wherein said portion of said composite preform comprises an identified region of local overheating caused by said resin curing exothermically.

12. The system of claim 11, wherein said heat sink is a passive heat sink formed of an endothermic material.

13. The system of claim 12, wherein said passive heat sink comprises a thermoplastic patch, said patch having a melting temperature equal to or less than an exotherm peak temperature of said resin.

14. The system of claim 11 wherein said heat sink is an active heat sink.

15. The system of claim 14 wherein said active heat sink comprises a thermoelectric cooling device.

16. The system of any one of claims 11 to 15 further comprising:

a tool having an upper tool surface, said lower surface of said composite preform being located on said tool surface;

a first vacuum bagging film extending over said composite preform and sealed relative to said tool surface to define a first cavity between said first vacuum bagging film and said tool surface, said composite preform being located in said first cavity; and

a vacuum source communicating with said first cavity;

wherein said heat sink is located above said first vacuum bagging film in proximity to said upper surface of said composite preform.

17. The system of claim 16, further comprising:

a second vacuum bagging film extending over said first vacuum bagging film and said heat sink and sealed relative to said tool surface to define a second cavity between said first and second vacuum bagging films:

wherein said vacuum source communicates with said second cavity and said heat sink is located in said second cavity.

18. The system of any one of claims 11 to 17 wherein said composite preform has a non-uniform thickness measured between said upper and lower surfaces, said portion of said composite preform having a thickness greater than an average thickness of said composite preform.

19. The system of any one of claims 11 to 18, wherein said resin is to be infused into said composite preform.

20. The system of any one of claims 11 to 18, wherein said composite preform comprises a plurality of plies of prepreg composite material containing said resin.