ELECTRICAL INSULATION MATERIAL

TECHNICAL FIELD

This invention relates to materials suitable for electrical insulation applications.

BACKGROUND

Electrical equipment such as electric motors, generators, and transformers often require some form of dielectric insulation to separate a conductor at one voltage from a conductor at a different voltage and/or to provide mechanical protection to electrical components. Laminates of electrical insulation materials are often used in the industry for this purpose. Examples of such materials are described in WO 2012/082180; JP 2000/008299; CA 2003221; and JP 9158092.

SUMMARY

There is a need in certain electrical insulation applications for materials that achieve a high flame resistance rating (e.g., UL 94V-0) while still providing superior mechanical strength and retained flexibility after heat aging.

The materials according to the embodiments of the present invention are suitable for insulating electrical components in transformers, motors, generators, and other devices requiring insulation of electrical components, particularly those that have flame retardancy requirements. At least some embodiments of the present invention provide a unique flexible electrical insulation article having excellent mechanical strength, flexibility, and flame resistance. At least some embodiments of the present invention are able to achieve high flame resistance ratings even though they contain some flammable materials. At least some embodiments of the present invention provide an electrical insulating material having a desirable balance of properties including flame retardancy, dielectric strength, tensile strength, and tear strength. At least some embodiments of the present invention further provide desirable thermal conductivity properties.

At least one ~~embodiment~~ aspect of the present invention provides an article comprising a non-cellulosic nonwoven fabric layer having first and second opposing major surfaces and having a non-cellulosic nonwoven paper layer attached to each major surface of the nonwoven fabric layer wherein one or both of the nonwoven paper and nonwoven fabric are electrically insulating.

As used in this specification:

"non-cellulosic" means containing less than 10 wt% cellulosic material, preferably containing less than 5 wt% cellulosic material, more preferably containing only trace amounts of cellulosic material, and most preferably containing no cellulosic material.

"directly fused" means having no intervening layer such as an adhesive layer;

"nonwoven paper" means a sheet material primarily comprised of short fibers;

"nonwoven fabric" means a sheet material primarily comprised of long fibers;

"short fibers" means fibers less than one inch long;

"long fibers" means fibers greater than or equal to one inch long;

What is claimed is:

1. An article comprising:

a non-cellulosic nonwoven fabric layer having first and second opposing major surfaces and having a non-cellulosic nonwoven paper layer attached to each major surface of the nonwoven fabric layer wherein one or both of the nonwoven paper and nonwoven fabric are electrically insulating.

2. The article of claim 1 wherein at least one of the nonwoven paper layers is directly fused to the nonwoven fabric layer.

3. The article of claim 1 wherein at least one of the nonwoven paper layers is attached to the nonwoven fabric layer by an adhesive.

4. The article of claim 3 wherein the adhesive comprises a flame retardant.

5. The article of claim 4 wherein the adhesive comprises up to 30 wt% flame retardant.

6. The article of claim 4 wherein the adhesive comprises up to 50 wt% flame retardant.

7. The article of claim 1 comprising multiple alternating layers of nonwoven paper and nonwoven fabric, wherein both exterior layers are nonwoven paper.

8. The article of claim 7 comprising five alternating layers.

9. The article of claim 1 ~~or claim 7~~ wherein at least one of the nonwoven paper layers comprises more than one sheet of nonwoven paper.

10. The article of claim 9 wherein the sheets comprising at least one of the nonwoven paper layers have different properties.

11. The article of claim 10 wherein the different properties are selected from the group consisting of thickness, composition, density, flexibility, tear strength, tensile strength, dielectric strength, and flame resistance.

12. The article of claim 1 wherein the nonwoven fabric layer comprises more than one sheet of nonwoven fabric.

13. The article of claim 7 wherein at least one nonwoven fabric layer comprises more than one sheet of nonwoven fabric.

14. The article of claim 12 wherein the sheets comprising at least one of the nonwoven fabric layers have different properties.

15. The article of claim 14 wherein the different properties are selected from the group consisting of thickness, composition, density, flexibility, tear strength, tensile strength, dielectric strength, and flame resistance.