

금속사복합직물의 열적 성능

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Thermal Behavior of Multifunctional Metal Composite Fabrics

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1. Introduction

Low emissivity and high radiative reflectance of the metal component of metal composite fabrics are important factors affecting the thermal behavior of these fabrics. Metals are great conductors of thermal energy but due to their low thermal emissivity they reflect the thermal radiation from a heat source. Thus, clothing made of metal composite fabrics will radiate body heat from back to the wearer. while reflecting heat radiation from the outside to keep the body cool. In this paper, the effects of metal type, metal yarn density, metal grid shape on the thermal behavior of the metal composite fabrics were investigated.

2. Materials and Methods

Fabrication of metal composite yarns and fabrics

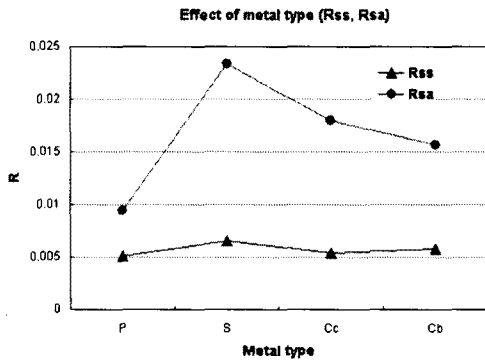
Metal composite yarns were produced with commercially available metal filaments (stainless steel filament with diameter 0.035mm, polyesterimide-coated or non-coated silver-plated copper with diameter 0.040mm) and polyester filaments (75/72^D). Metal composite fabrics were constructed in a plain weave (25.2×25.2/cm²). The metal composite yarns were inserted in certain intervals to obtain different grid structures of metal within the fabrics, which resulted in different metal densities.

Thermal characteristics and comfortability measurements

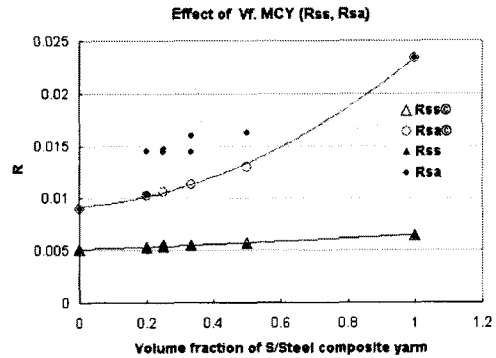
KES F7_II Thermo Labo II were used for measuring the conductive thermal resistance (R_{ss} : thermal resistance from 35°C hot solid to 20°C cold solid). ThermDAC hotplate system were used for measuring the convective thermal resistance (R_{sa} : thermal resistance from 35°C hot solid to 20°C cold air, R_{aa} : thermal resistance from 35°C hot air to 20°C cold air).

3. Results and Discussion

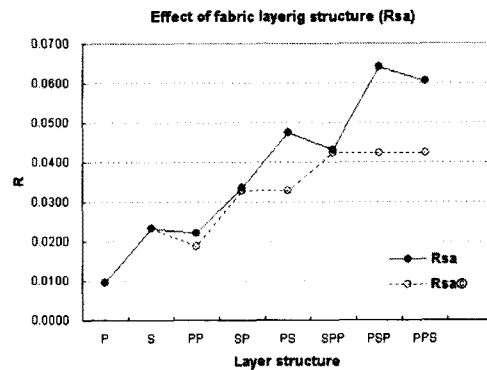
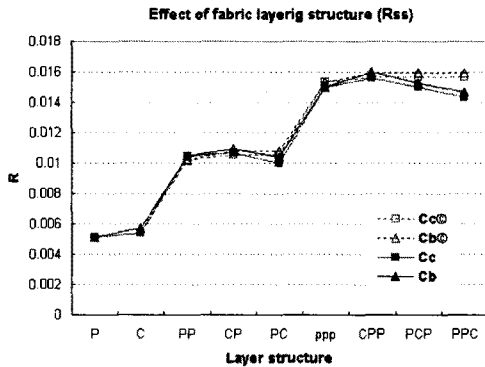
Effect of metal Type



Effect of metal yarn density



Effect of fabric layering structure



4. Conclusion

All metal composite fabrics showed higher thermal resistance than polyester. Stainless steel composite fabric showed the highest solid to solid thermal resistance (Rss) and solid to air thermal resistance (Rsa). Copper composite fabric showed the highest air to air thermal resistance (Raa). Among the three metals, the introduction of stainless steel significantly enhanced the convective thermal resistance (Rsa) of the metal composite fabric.

Layering the metal composite fabrics with polyester gave a structure free of convective conduction, thus we were able to confirm the increase in convective thermal resistance due to metal incorporation, When a material with high thermal conductivity is placed adjacent to a heat source or cold source the heat transfer mechanism accelerates, dropping the thermal resistivity.

Thus the thermal behavior of the metal composite fabrics can be regulated with metal type, metal grid geometry and layering structures of the fabrics.

5. Acknowledgements

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