# Study on preparation and properties of aramid/stainless steel fiber blended electromagnetic shielding fabric



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## 1. Introduction

In this study, aramid/stainless steel fiber blended yarn was used to prepare high-performance electromagnetic shielding(EMS) woven fabrics, which can shield electromagnetic waves and have flame retardant property.

## 2. Experiments

2.1.Materials and Sample preparation

Aramid/stainless steel fiber blended yarn: Its blending ratio and linear density are 37/63 and 97.2tex, respectively.(Fujian Qianglun New Material Co., Ltd.).

Sample preparation: Semi-automatic weaving machine was used to weave EMS fabrics with different structures, which are plain weave, 1/2 twill weave, and 5/3 warp satin weave.

Appratus: SLo-01 semi-automatic weaving machine.

2.2 Test Methods

EMS performance: DR-913G fabric electromagnetic radiation resistance tester

Flame retardancy: YG (B) 815D-I fabric flame retardant performance tester

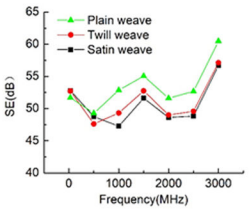
Tensile properties: INSTRON universal material testing machine

## 3. Results and discussion

3.1.EMS performance of aramid/stainless steel fiber blended fabric

3.1.1. Effect of fabric structure on EMS performance.

Conditions: The EMS performance of fabrics with different structures were tested over frequency range of 30 to 3000 MHz.

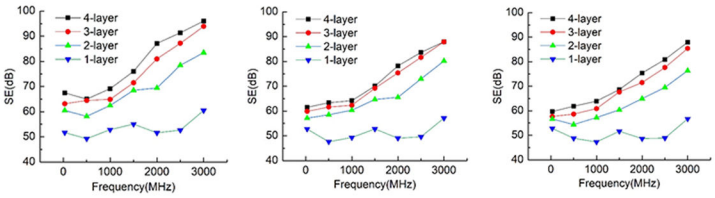



Results:The electromagnetic shielding effectiveness(EMSE)of the satin weave is the worst.The satin weave has the longest floating length among three fabrics.Also,it has loose structure and high porosity,which results in the worst EMSE of the satin among the three fabrics.

3.1.2. Effect of fabric thickness on EMS performance.

Conditions: The EMS performance of fabrics with different thickness were tested over frequency range of 30 to 3000 MHz.

Results: It can be found that the EMSE enhances as the fabric thickness increases.The reason may be that when the thickness of the fabric increases, the incident depth of the electromagnetic wave increases, and the intensity of the electromagnetic wave decreases with an exponential relationship.

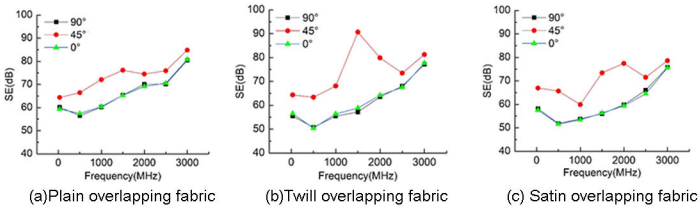



(a)Plain overlapping fabric (b)Twill overlapping fabric (c) Satin overlapping fabric

3.1.3. Effect of fabric overlap angle on EMS performance.

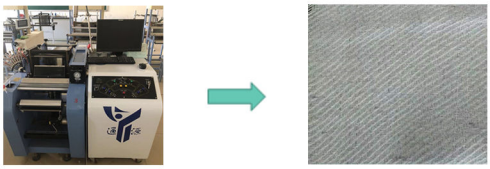
Conditions: The three fabrics were overlapped in pairs with the angles of 0°, 45° and 90°, respectively, and the EMS performance were tested over frequency range of 30 to 3000 MHz.

Results: The EMSE of fabrics overlapped at 45° is better than that of the fabrics overlapped at 0° and 90°.The reason is that the fabrics overlapped at 45° have a large number of warp and weft interlacing times, which reduced the porosity significantly, and therefore the electromagnetic wave transmission decreased.




(a)Plain overlapping fabric (b)Twill overlapping fabric (c) Satin overlapping fabric


Aramid fiber Stainless steel fiber Aramid/stainless steel fiber blended yarn


Weaving machine Aramid/stainless steel fiber blended fabric

| Fabric types | Warp density (number/10cm) | Weft density (number/10cm) | Fabric thickness (mm) |
|---|---|---|---|
| Plain weave | 118 | 105 | 0.44 |
| Twill weave | 118 | 105 | 0.57 |
| Satin weave | 118 | 105 | 0.60 |

3.2. Flame retardancy of aramid/stainless steel fiber blended fabric

No afterburning phenomenon occured after the ignition.The damage length is short.The smoldering time is slightly longer,and no melting or dripping appeared.This shows that the flame retardant performance of the aramid/stainless steel fiber blended woven fabric is relatively good.

| Fabric types | Afterburning time (s) | Smoldering time (s) | Damage length (mm) |
|---|---|---|---|
| Plain weave | 0 | 10.3 | 19 |
| Twill weave | 0 | 7.8 | 14 |
| Satin weave | 0 | 9.5 | 17 |

3.3. Tensile properties of aramid/stainless steel fiber blended fabric

The aramid/stainless steel fiber blended yarn used in this study has strong tensile strength itself, therefore the tear strength of the fabric is great and its tensile performance is excellent. With the same fabric material, the tear strength of plain and satin significantly higher than that of twill.

| Fabric types | Tear strength (N) | | Elongation at break (%) | | Tear length (mm) | |
|---|---|---|---|---|---|---|
| | Warp direction | Weft direction | Warp direction | Weft direction | Warp direction | Weft direction |
| Plain weave | 844.33 | 806.71 | 9.79 | 9.21 | 30.89 | 29.13 |
| Twill weave | 735.25 | 699.53 | 11.35 | 10.84 | 33.28 | 32.05 |
| Satin weave | 935.28 | 897.69 | 8.87 | 8.29 | 28.45 | 27.22 |

## 4. Conclusions

(1) The aramid/stainless steel fiber blended woven fabric has good EMS performance. In terms of the fabric structure, plain weave has the best EMSE among the three types of fabrics.In multi-layer fabrics, the greater the number of overlapping layers, the higher the EMSE of the fabric. Among the fabrics that overlap at different angles, the EMSE at the fabric overlap angle of 45° is the highest.

(2) The aramid/stainless steel fiber blended woven fabric is a good flame retardant material.

(3) The aramid/stainless steel fiber blended woven fabric has strong tensile strength, strong tear strength and excellent tensile properties, which can be used to prepare high-performance fabrics.