The 14th Symposium on Composite Materials for Automotive Applications, (Oct. 28th, 2022)

R&DC-ACM

母材にセルロースナノファイバを添加した開繊炭素繊維強化複合材料の疲労特性の向上

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今出川花子[2)], 同志社二郎[3)]

1. 背景

炭素繊維強化プラスチック
Carbon Fiber Reinforced Plastic

先行研究

平織CFRP

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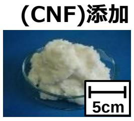
母材にセルロースナノファイバ(CNF)添加



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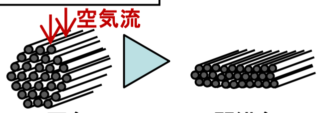
空気式開繊



従来品よりも薄く優れたプリプレグ成形可能

川邊和正：繊維学会誌, 64, 8, (2008), pp.18-23

疲労寿命への効果は？

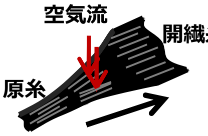
目的

開繊炭素繊維を強化材に用いたCFRP(開繊CFRP)の母材にCNFを添加し，疲労特性に与える影響を明確化

2. 実験材料

2.1 CNF添加開繊炭素繊維プリプレグ

炭素繊維束
TR50S15L
引張強度：4.9GPa
ヤング率：240GPa
(三菱レイヨン(株))



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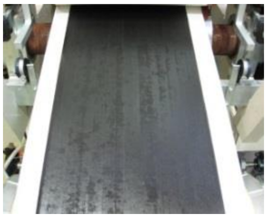
CNF添加エポキシ樹脂フィルム

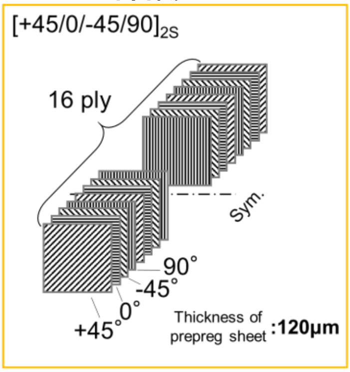


開繊炭素繊維プリプレグシート
(V_f = 57%)

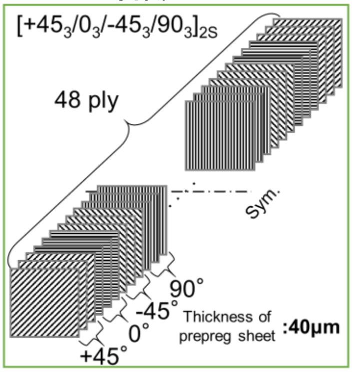
2.2 積層構成

作製したプリプレグシートを積層

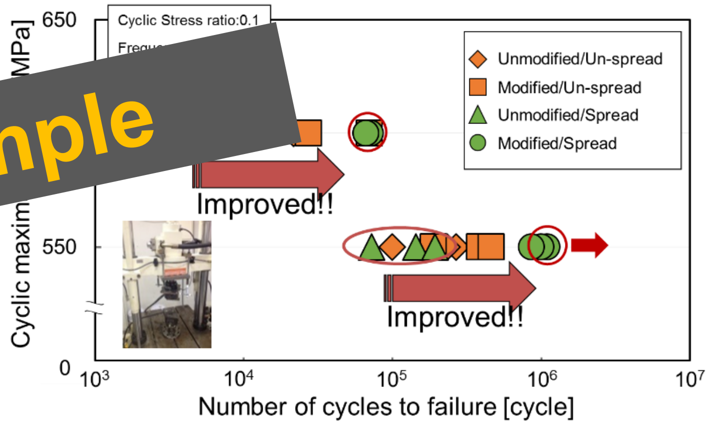
未開繊CFRP



開繊CFRP



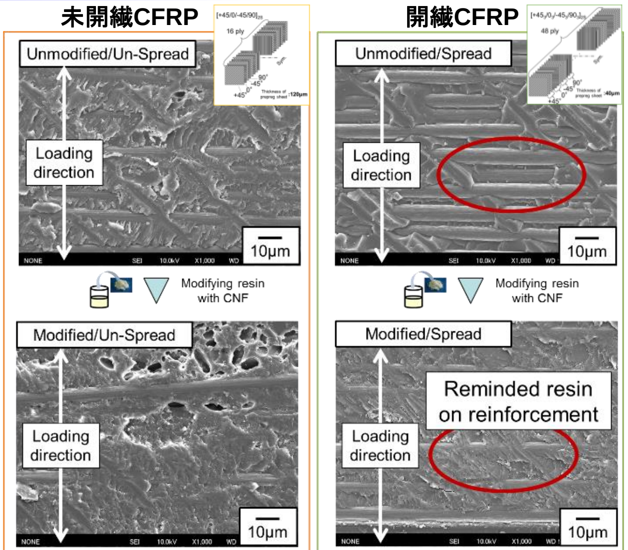
3. S-N線図



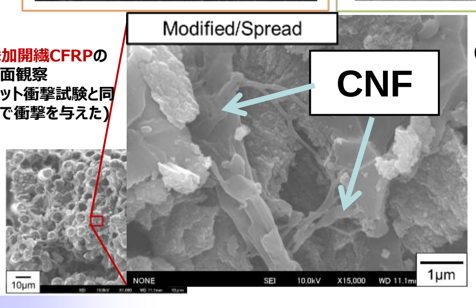
強化材に開繊炭素繊維を使用 → CNFの添加によるCFRPの疲労寿命改善率大

4. 疲労破面様相

疲労破断後の破面をSEM観察



CNF添加開繊CFRPの衝撃破面観察
(アイゾット衝撃試験と同等手法で衝撃を与えた)



CNFが繊維束内部にまで存在

↓

CNFの母材添加によって開繊CFRPの疲労寿命改善

5. 結論

強化材に開繊炭素繊維を選択した場合には，未開繊炭素繊維を選択した場合よりもCNFの母材添加による疲労寿命の改善効果が大きく得られることがわかった．

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同志社大学 理工学研究科 構造工学研究室, 2) 福井県工技センター, 3) DIC

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Mg/AL2O3界面反応を利用したナノ粒子分散マグネシウム複合材料の微細組織制御

藤原弘, 京都太郎, 宮本博之, 今出川花子[2)]

Introduction

Mg composites containing fine Al_2O_3 particles were produced using a powder metallurgy technique and exhibited superior mechanical properties.

Pure Mg particles + Al_2O_3 particles → Mechanical Milling → Spark Plasma Sintering (SPS)

Hardness is increased by containing Al_2O_3 particles

Hardness is further increased because nanoparticles are generated during sintering

↓ But

We have not known the formation mechanism of nanoparticle

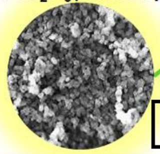
Aim

In this study, we investigated nanopart… …etail.

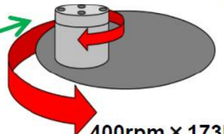
Experimental Pro…

Mg(Ave.180μm)

α-Al_2O_3(Ave.0.3μm,10vol%)



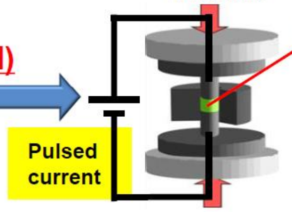
Mechanical Milling(MM)



Planetary ball mill

Ball	Material	WC	
	Weight	7.79g	
	Diameter	10.0mm	
	Number	10	
Powder	Weight	10g	
Atmosphere	Ar		

…ma Sintering(SPS)

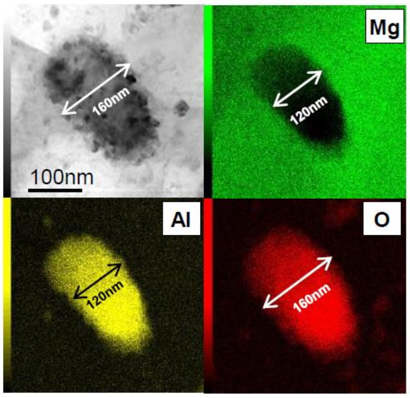


Pressure	40MPa
Temperature (Holding Time)	773K (1.2ks)
Temperature (Holding Time)	713ks (0.6~7.2ks)
Atmosphere	10Pa

Evaluation method

SEM,TEM XRD

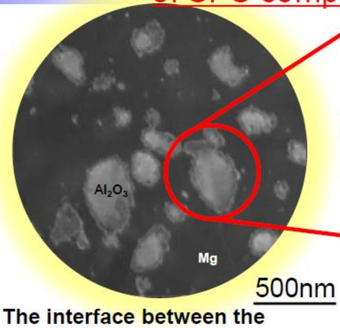
EDS mapping



MgO particles were formed at the interface between the Mg and Al_2O_3.

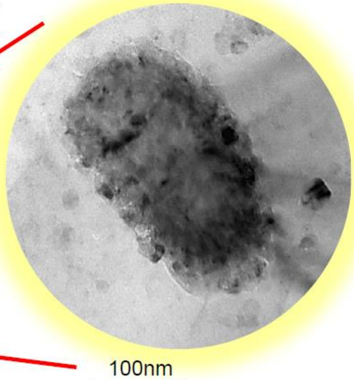
Results

SEM image of SPS compact

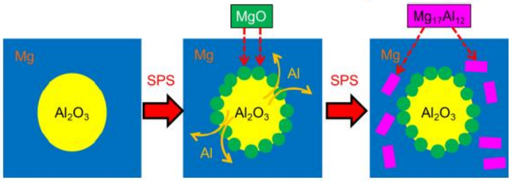


The interface between the Mg and Al_2O_3 is not clear.

TEM image of SPS compact

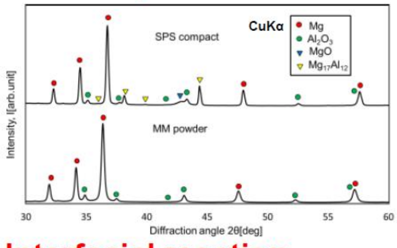


Equiaxed nanoparticles are formed at the interface between the Mg and Al_2O_3.



After reaching the solubility limit of Al to Mg, it reacts with the Mg matrix to form $Mg_{17}Al_{12}$.

XRD analysis

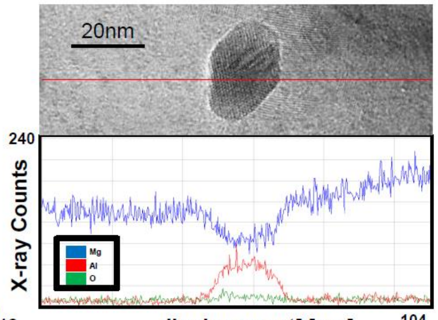


Interfacial reaction

$$35Mg + 6Al_2O_3 \rightarrow 18MgO + Mg_{17}Al_{12}$$

MgO and $Mg_{17}Al_{12}$ phases are formed via the SPS process.

EDS Line Analysis of nano particle



$Mg_{17}Al_{12}$ plate-like nanoparticle is formed in Mg matrix at the position of several hundred nm from Al_2O_3.

Results

1. The Mg/Al_2O_3 composite was fabricated by mechanical milling and spark plasma sintering process.
2. the microstructure formation process during sintering is studied.
3. MgO with the size of about 10 nm is formed at the interface between Mg and Al_2O_3.
4. $Mg_{17}Al_{12}$ in Mg matrix is formed at the position of several hundred nm from the Al_2O_3 particle.

同志社大学 理工学部 金属材料科学研究室, 2) 玉川大学