# Short duration DPF regeneration by using high robustness designed DPF

P20241024-ECMA

# Emission regulation



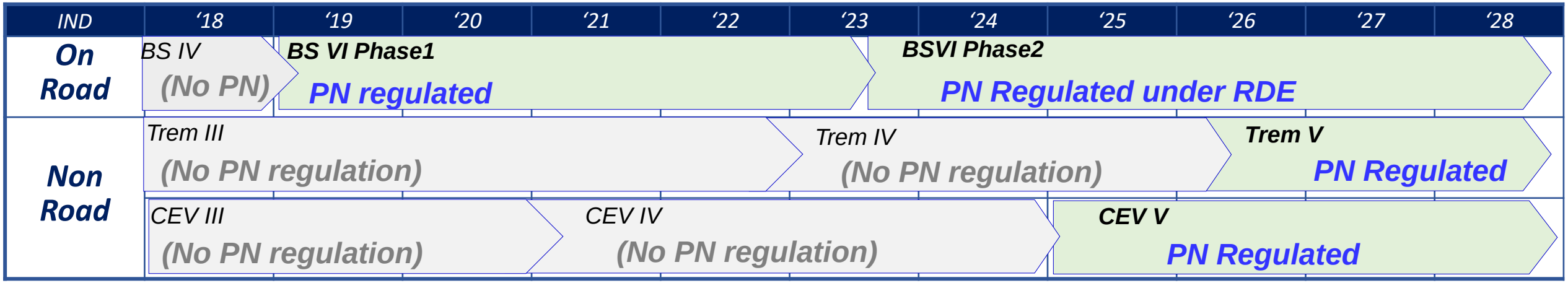



**Table Comparison of PM/PN regulations and ATS layout in Trem/CEV *IV* and Trem/CEV *V***

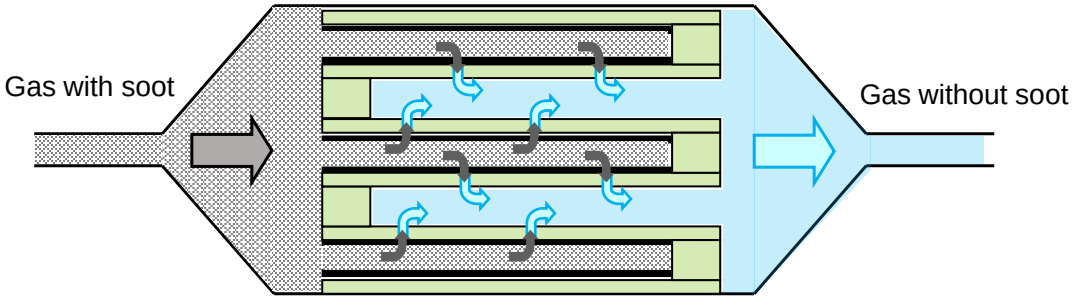
| | PM | PN | main ATS layout |
|---|---|---|---|
| Trem/CEV *IV* *(No PN regulation)* | 0.025 | - | E/G → DOC |
| Trem/CEV *V* ***(PN regulation)*** | 0.015 | $1.0\times10^{12}$ | E/G → DOC → DPF<br>DPF mandatory to meet PM/PN regulation |

# ■ DPF system



## ☐ Diesel car needs DPF system

PN/PM filtration by DPF




Steps to regeneration

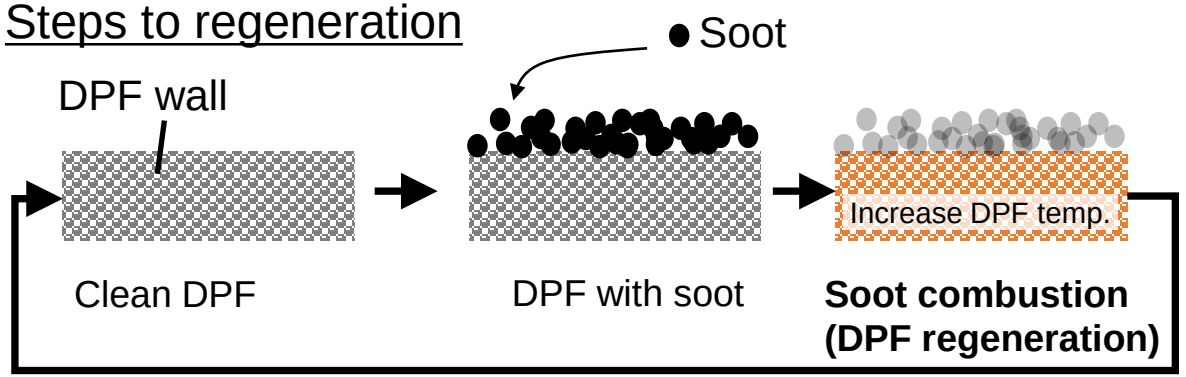


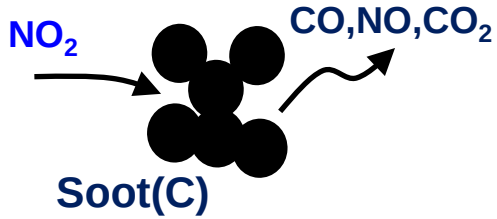

**Table Passive regeneration and active regeneration comparison**

| | Passive | Active | |
|---|---|---|---|
| Timing | During driving | During driving | Parked regeneration (Reset regularly) |
| Temperature | 250°C~ | 550°C~ | 550°C~ |
| Regeneration speed | Low | High | High |
| While regeneration | Vehicle running | Vehicle running | **Vehicle stop** |
| System risk | - | **Abnormal regeneration /ATS damage** | **Abnormal regeneration /ATS damage** |

## Soot combustion type

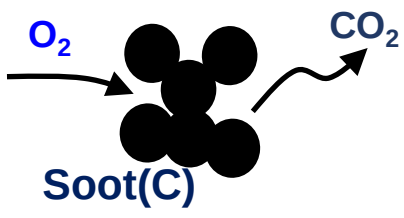
■ **NO2 regeneration (250°C~)**

- $2NO_2 + C \rightarrow 2NO + CO_2$
- $NO_2 + C \rightarrow NO + CO$




■ **$O_2$regeneration (550°C~)**

- $C + O_2 \rightarrow CO_2$



# ■ Value for end users in Non-road vehicle application



**On-road vehicle (Transportation vehicle)**

**Non-road vehicle (Working vehicle)**

Tractor

CEV

**Working vehicle**

When serious DPF damage occurred due to low robustness design , vehicle will not perform normally and need to stop until parts are changed in a worst case → Consume both time and money!

Passenger car : There are substitute public transportation (Train, Bus, Taxi, Ship and Air plane)
**Working vehicle :** No substitution! → Work needs to stop →High influence to end users

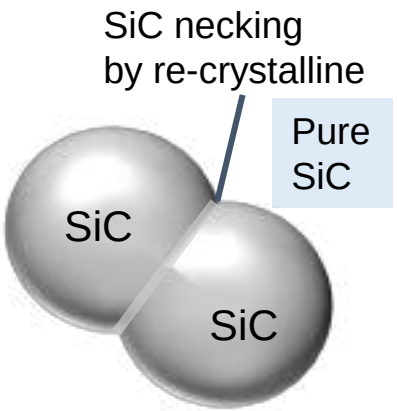
**Example :End users' workability decrease due to vehicle damage, but also DPF parked regeneration itself consumes time!**

**Robust DPF protect from damage and less parked regeneration duration are big value for end users**

# IBIDEN DPF : R-SiC characteristics



✓ R-SiC's high thermal conductivity makes it possible to accumulate more soot in DPF than that of Cordierite.




## R-SiC character

- Sharp pore distribution
- High chemical resistance
- High thermal conductivity

## Contribution for DPF

- Filtration
- Exhaust gas /ash resistance
- Thermal resistance (Soot capacity)

### Table DTI* test condition

| | |
|---|---|
| Test DPF | -Coated_Market Cord.<br>-Coated_R-SiC<br>] Similar cell structure |
| DTI trigger temp. | 550degC |
| Ramp up | Post injection |

*Drop-to-idle: Abnormal regeneration caused by supplying high-concentration oxygen to DPF when vehicle is in an idle state with the accelerator off during forced regeneration while driving.

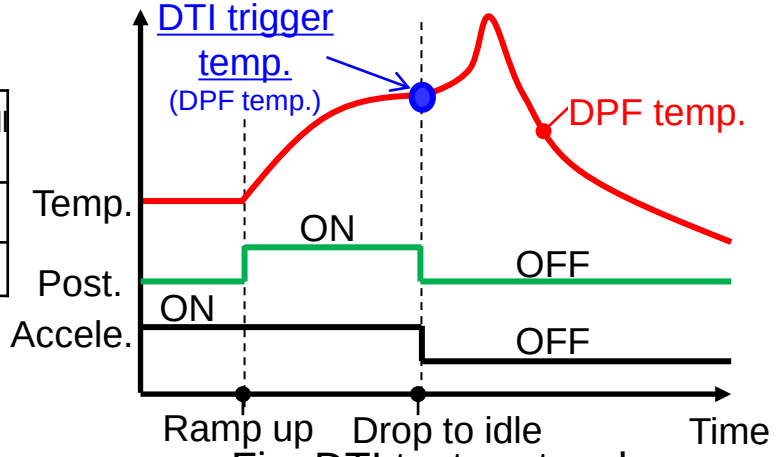



Fig. DTI test protocol

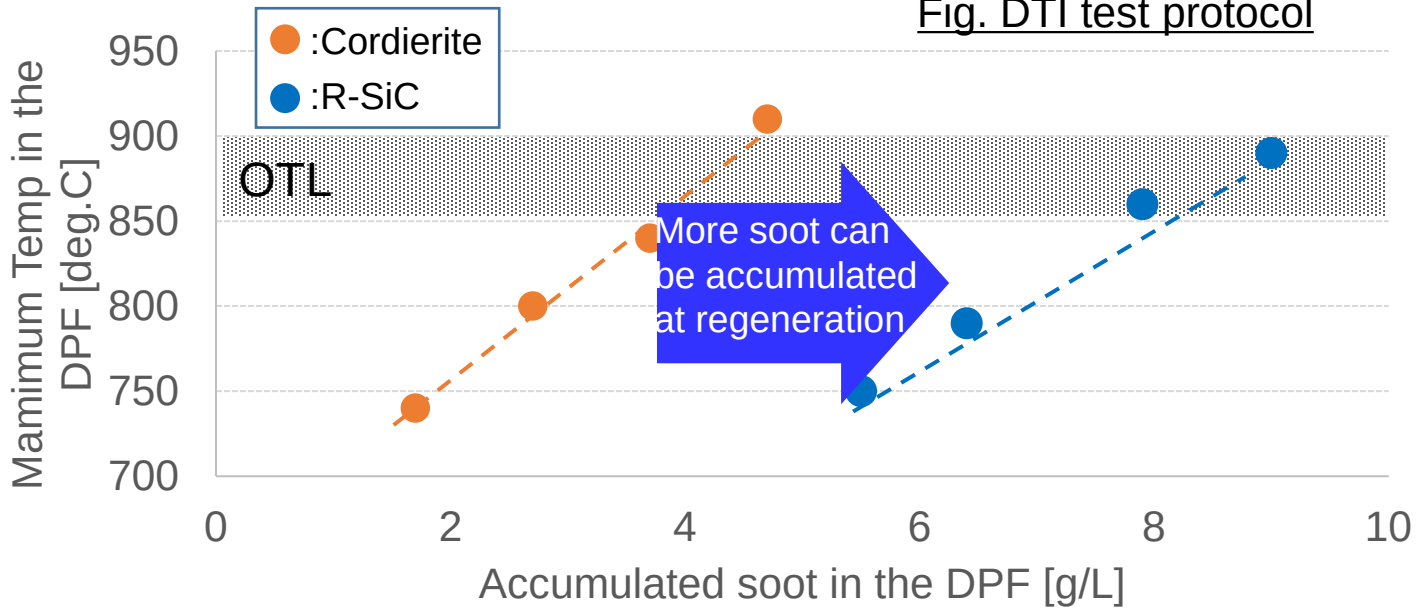



Fig. Maximum temperature in the DPF when DTI occurred

# ■ Short-time regeneration concept



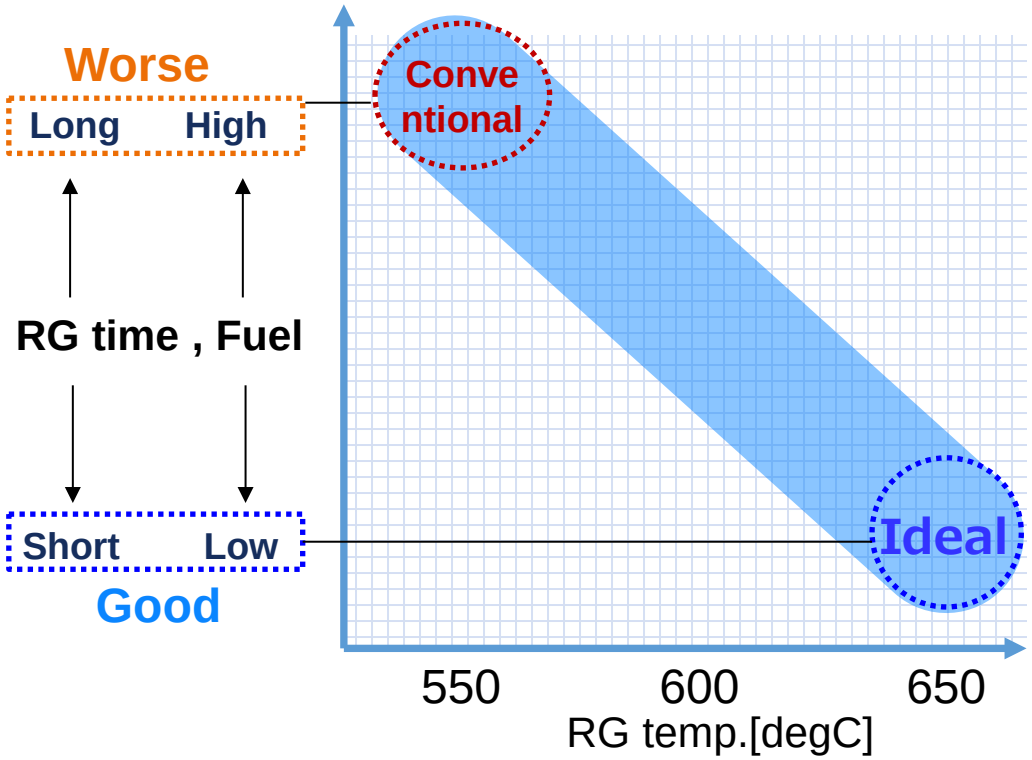
## Short time parked RG concept

Reaction rate formula

$$k = Ae^{-\frac{E}{RT}}$$

***k : Rate constant***
***T : Temperature,***
*A : Pre-exponential factor*
*E : Molar activation energy for the reaction*
*R : Universal gas constant*

➢ ***Increasing regeneration temperature =Short time soot regeneration***




## Abnormal regeneration risk confirmation

Table DTI* test condition

| | | |
|---|---|---|
| Test DPF | -Market Cord.<br>-R-SiC | Similar cell structure type |
| DTI trigger temp. | 550,600,650degC | |
| Ramp up | Post injection | |

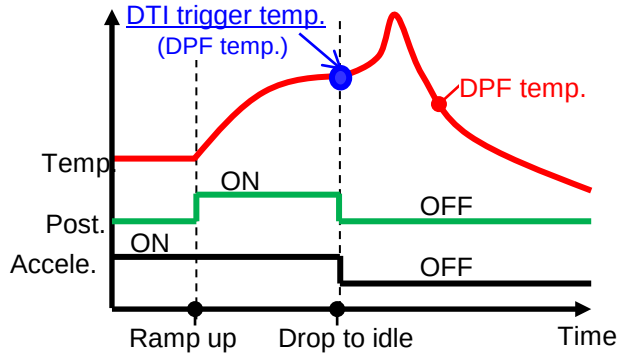
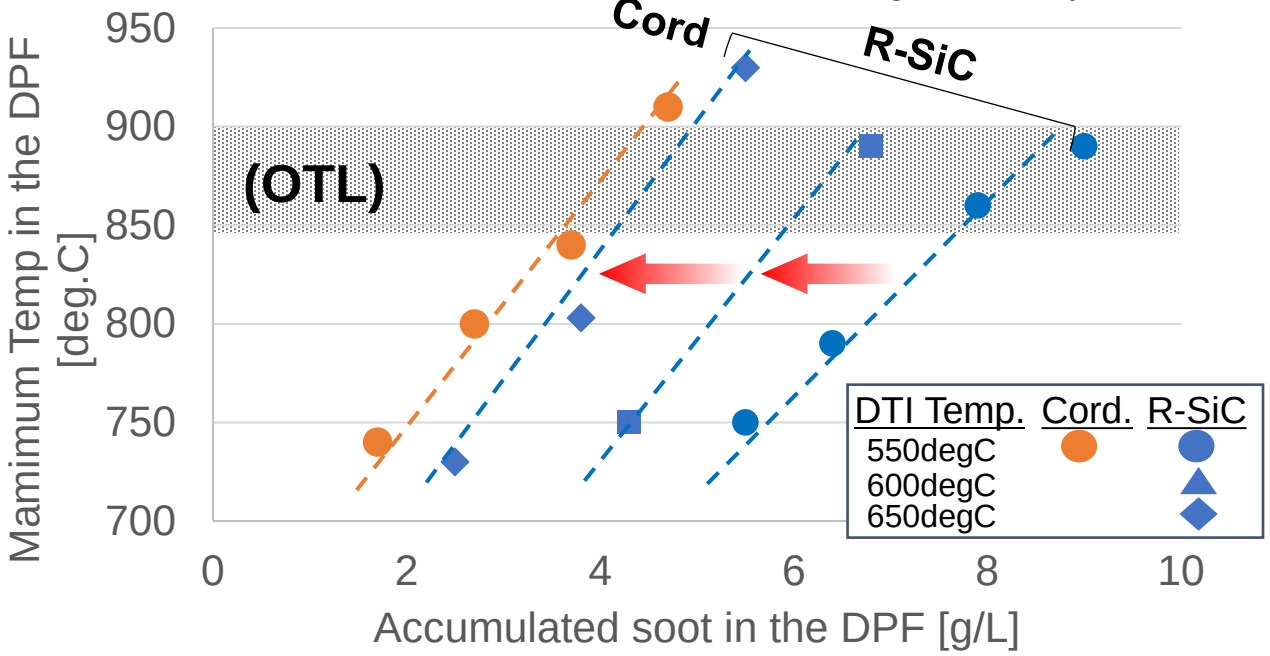



Fig. DTI test protocol




✓ ***R-SiC has higher soot capacity than Cordierite even when applying high regeneration temperature***

# ■ Parked regen. test under various gas temp. condition



✓ R-SiC has high SML→ Conduct High Temperature Regeneration possible.
➔ Reduction of regeneration duration and fuel consumption can be achieved.

Test image

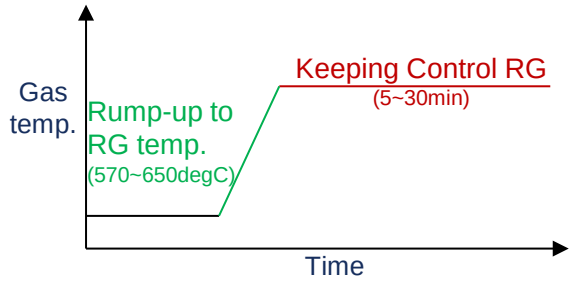
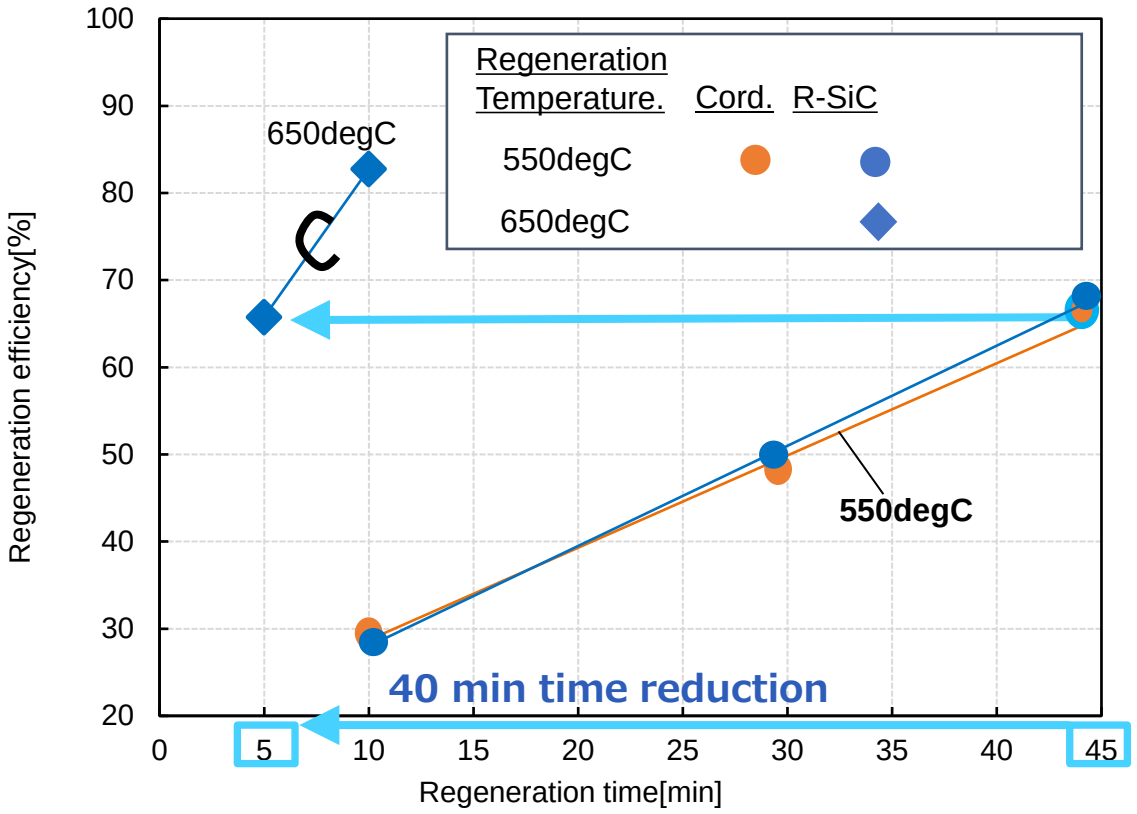


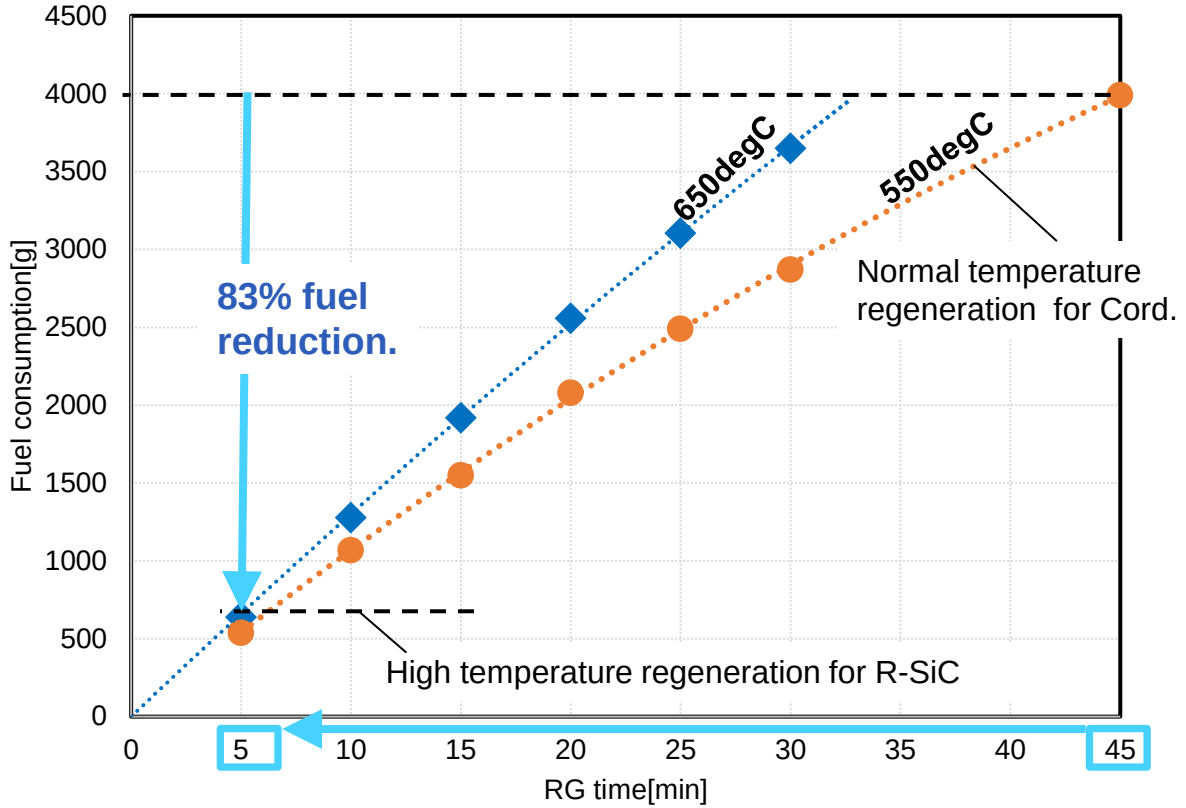

Table DPF information

| | |
|---|---|
| DPF size | D143.8x177.8mmL |
| Test DPF | -Coated_Market Cord.<br>-Coated_R-SiC |

Table Test condition condition

| | | |
|---|---|---|
| Engine type | | 1.6L_TC |
| RG condition | Soot amount | 5g/L |
| | Gas temp.(A-15mm) | **550~650 degC** |
| | Keep time | **5~45 min** |



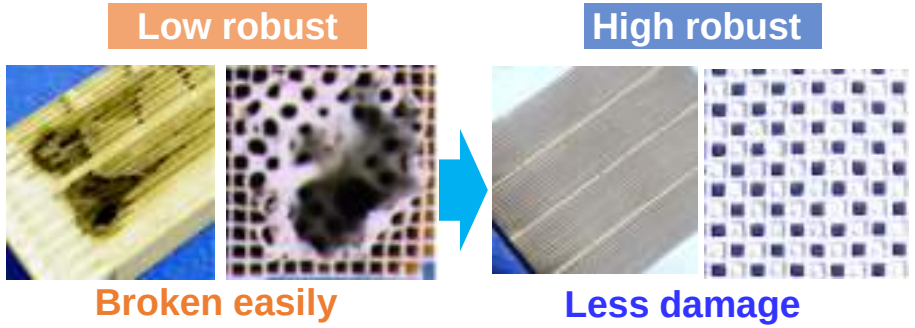



# Summary

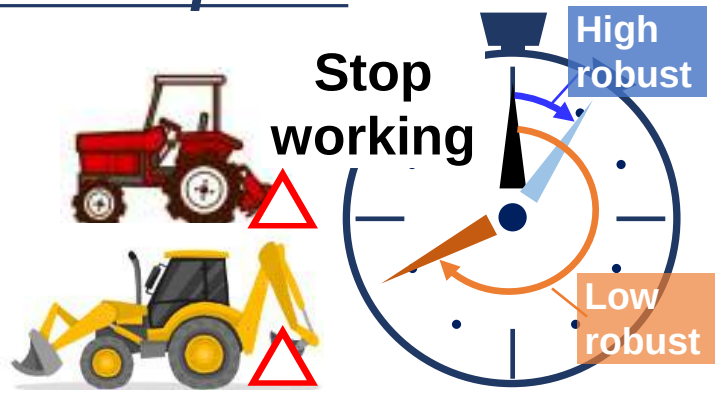


## *R-SiC High robustness contribution point*

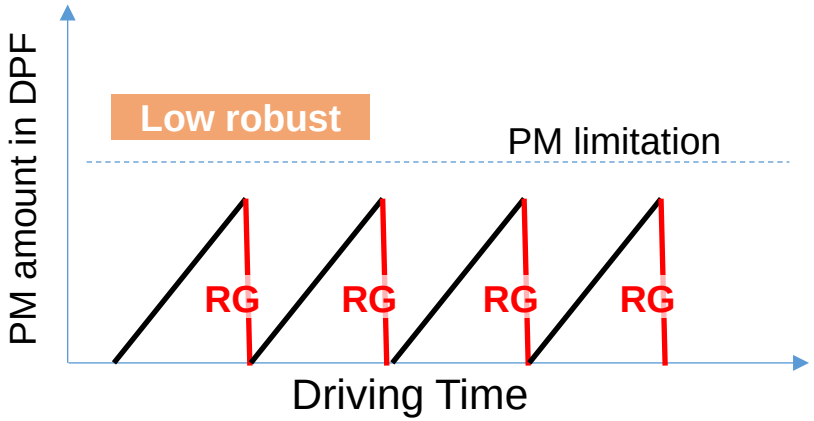
(if irregular regeneration happen)

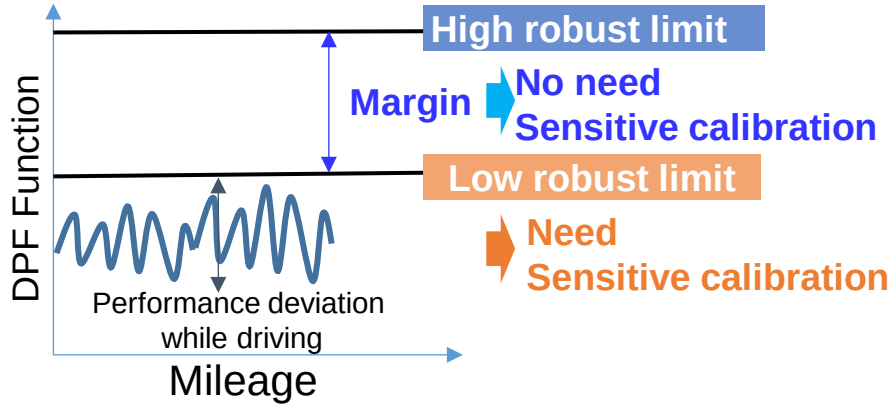



*Less DPF damage @ irregular DPF*

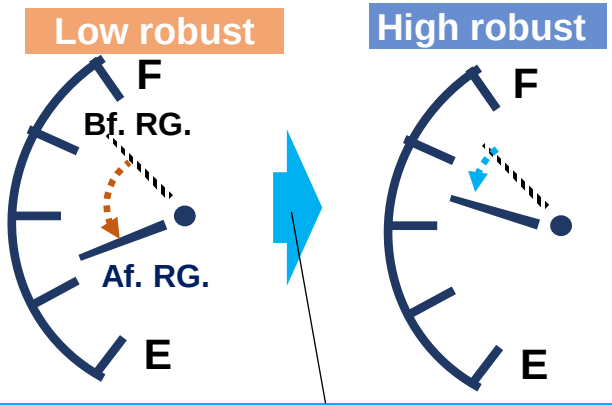



*Shorter stop working time*

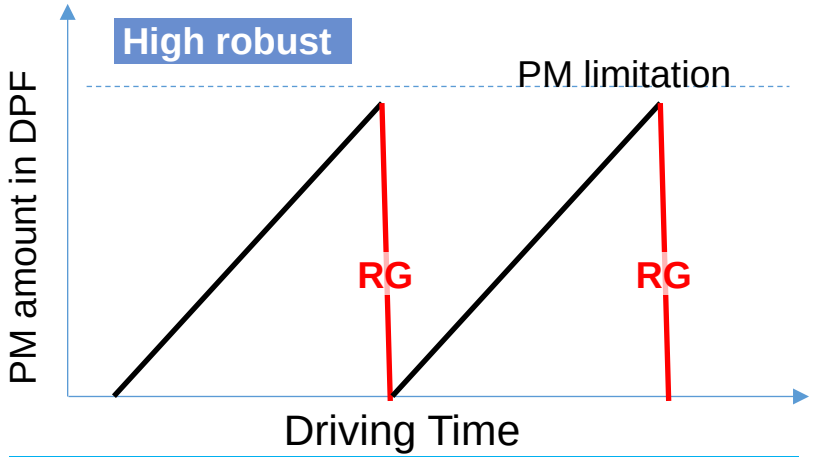



*Reduction of development resource/cost*




*Less fuel(CO2) consumption*




*Regeneration frequency reduction*

**R-SiC high robustness can contribute to secure longer working time of vehicle users, lower fuel consumption, and reduction of ATS calibration resources/cost**

*Thank you for your attention.*

*Let us support you more !!*

IBIDEN Co., Ltd.