

# 毫米波材料介電特性量測系統

## Dielectric Properties Measurement System in mmWave

### 技術簡介

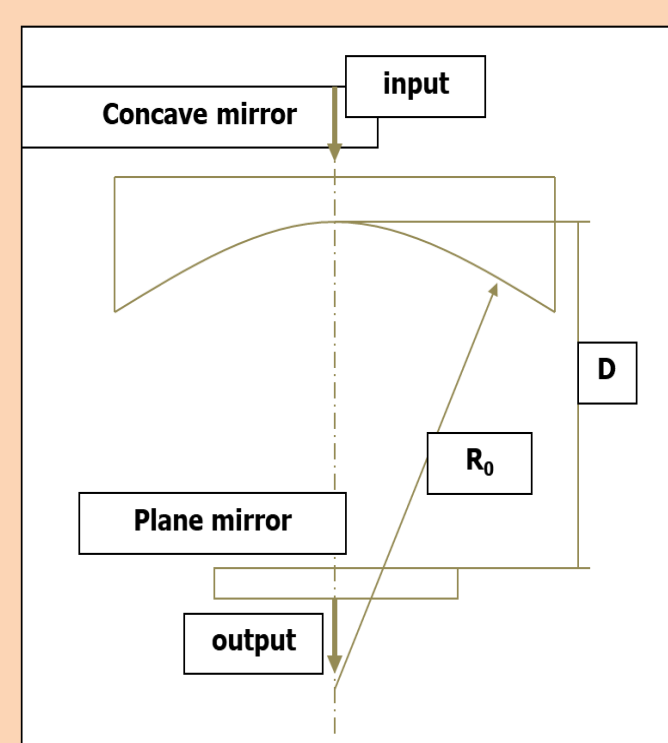
毫米波材料為發展5G 行動通訊之關鍵技術，國內缺乏毫米波材料的檢測技術能量，因此工研院以 Fabry-Perot 共振腔為基礎，進行20GHz – 110GHz 材料介電特性量測系統建置，透過高精度和低振動Motion 系統與整合式演算法，可將樣品精準定位於電場訊最強位置進行量測，量測自動化整合使系統可達成快速且簡易的量測，提供在毫米波新材料上特性之驗證與解決方案。

### 技術規格

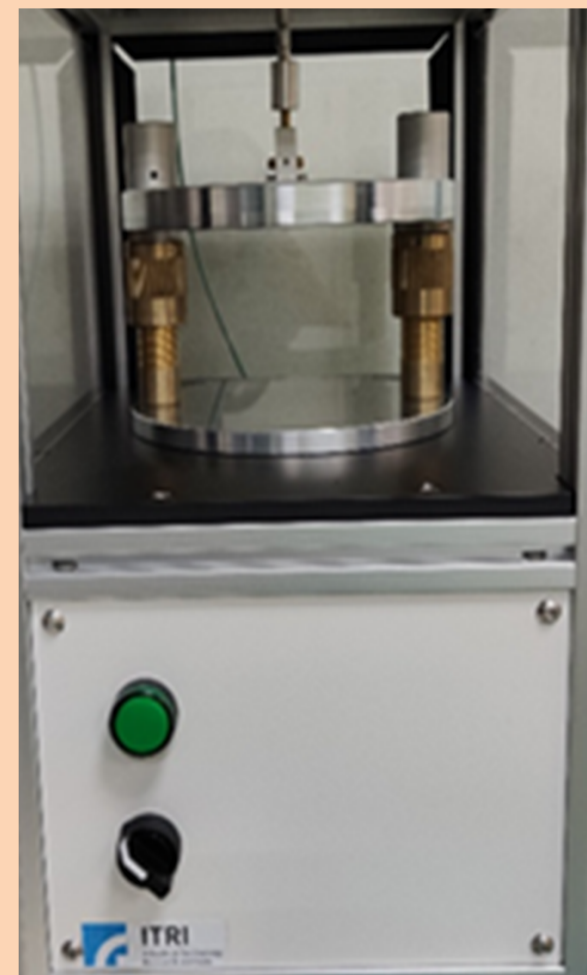
### 毫米波頻段材料介電特性量測技術服務及量測解決方案提供

毫米波頻段服務項目:

- 材料介電特性量測Dk, Df
- 材料介電特性量測諮詢
- 量測系統推廣服務
- 量測標準基板提供
- 規劃與舉辦能力試驗



Hemispherical Fabry-Perot open resonator (FPOR)



#### Technical characteristics

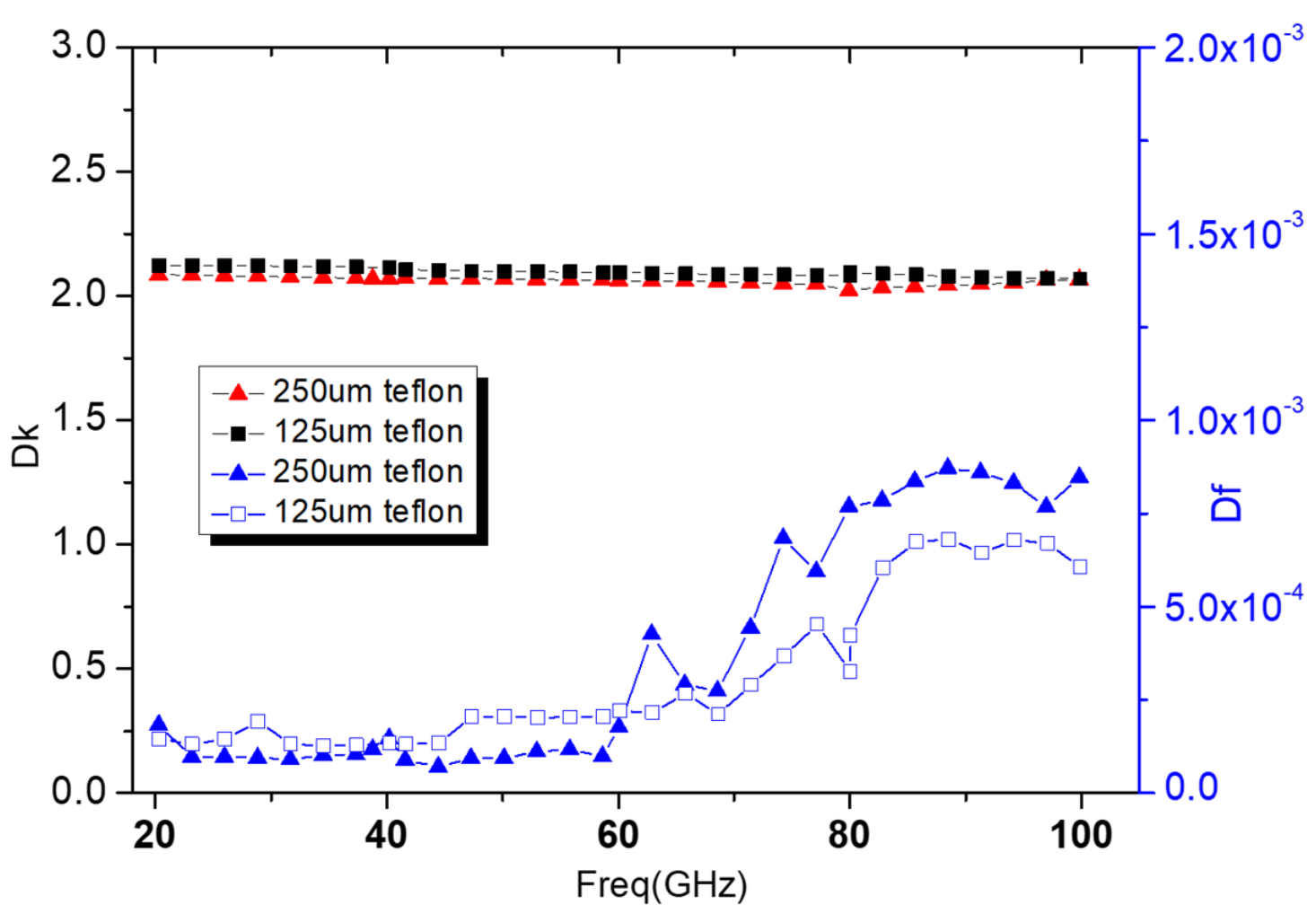
1. Cavity  $Q_{load}$  improved  
 •  $Q$  40,000  $\rightarrow$  100,000  
 • Loss tangent ( $D_f$ ) Measured up to  $10^{-6}$
2. Low  $D_k$  Material Measurement  
 •  $D_k$  Range 1~30  
 • Area larger than 6cm x 6cm
3. Five Frequency Section Design  
 • 20-40GHz; 40-60GHz; 50-80GHz  
 • 80-100GHz and 88-108GHz
4. Friendly Software Interface and Automation  
 • Automation  
 • Fast to Fast Measurement
5. Diversity Material Measurement  
 • PCB, CCL, Polymer Substrate  
 • Ceramic, Oxide or Complex Materials  
 • Sheet Molding compound materials

| Product   | Spec.  |
|-----------|--|
| IOP-2040  | F:20-40GHz; t: 2mm ~ 5um                           |
| IOP-4060  | F:40-60GHz; t: 1mm~5um                             |
| IOP-6080  | F:60-80GHz; t: 0.8mm~5um                           |
| IOP-80100 | F:80-100GHz; t: 0.6mm~5um                          |
| IOP-88108 | F:88-108GHz; t: 0.5mm~5um                          |
| FOP-20100 | F:20-110GHz; t: 0.5mm~5um                          |
| SOP-1001  | F: Single Freq. For Design                         |
| Option    | Thin Film; Automatic; High Q Design; Sample Holder |

| 頻段        | 測試方法           | 樣品厚度       | 樣品尺寸            |
|-----------|----------------|------------|-----------------|
| 10GHz     | SPDR           | 0.05~0.9mm | 30*30 ~ 80*80mm |
| 15GHz     | SPDR           | 0.05~0.5mm | 20*50 ~ 35*50mm |
| 20-110GHz | Open Resonator | 0.01~2mm   | 60*60 ~ 90*90mm |

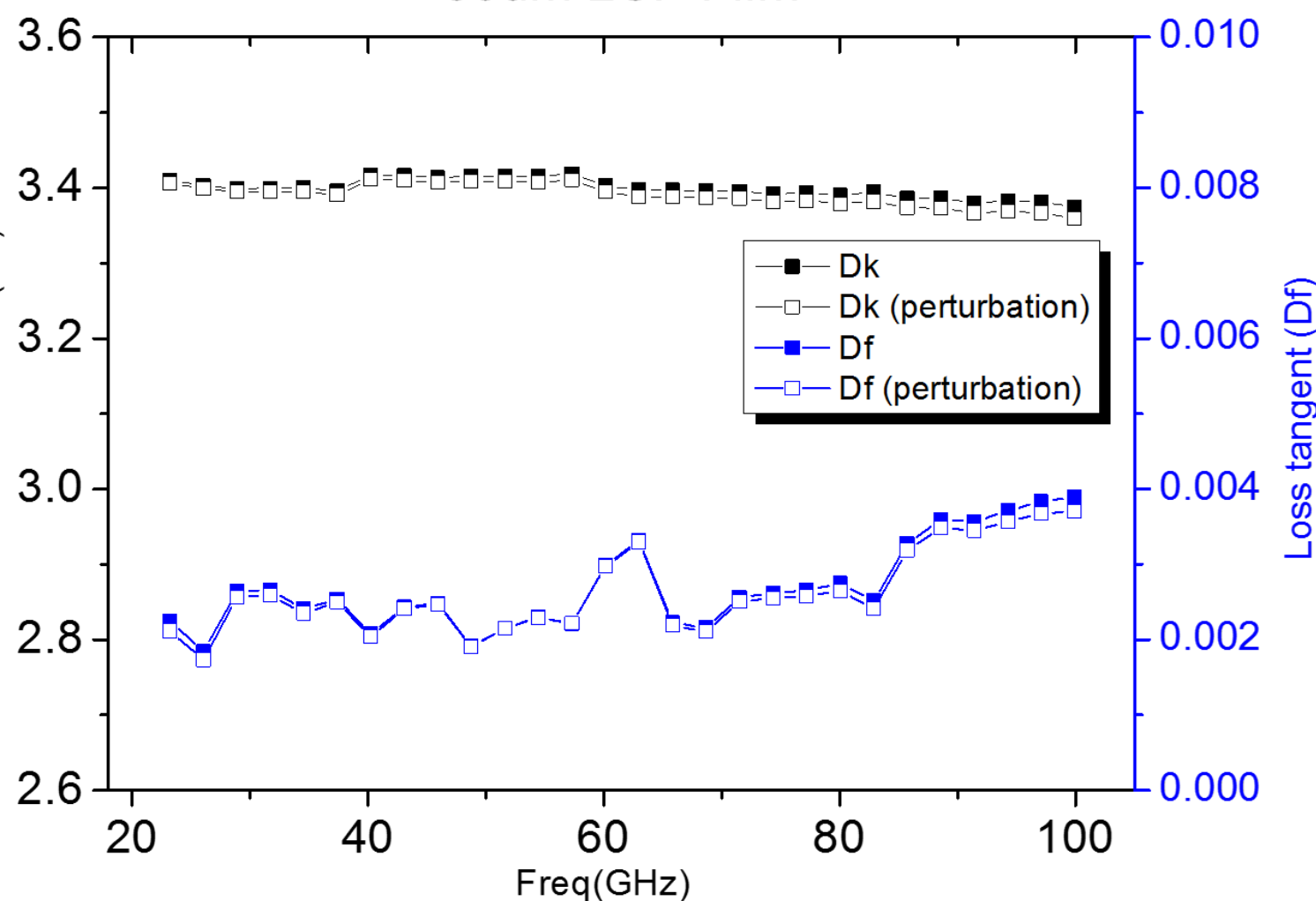
#### Testing result in 20GHz – 100GHz

250um and 125um teflon



#### Testing result in 20GHz – 100GHz

50um LCP Film

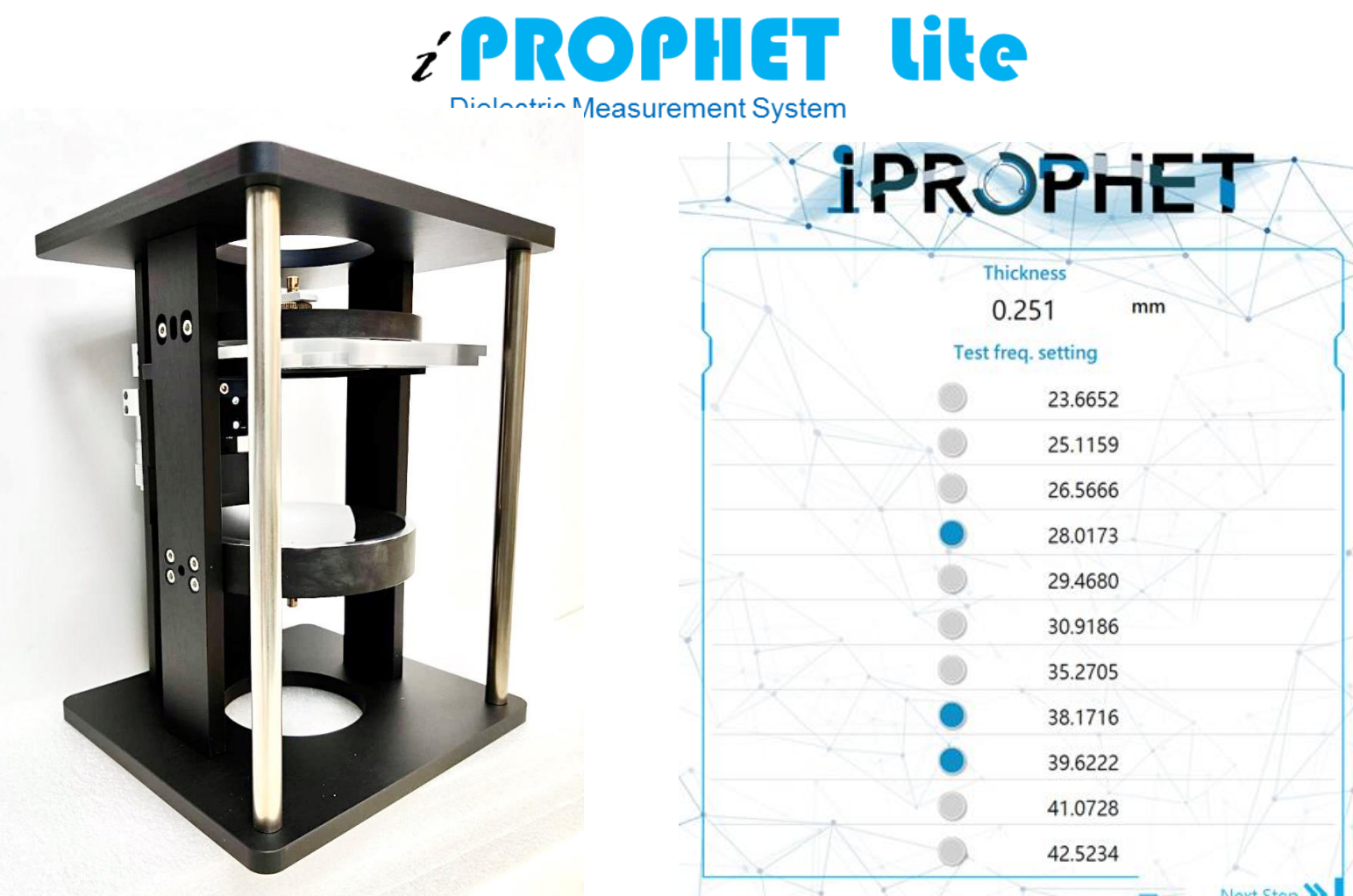


#### Uncertainty of System

| Material         | Thickness | Uc      | K | Expanded uncertainty U | Average   | Extended relative uncertainty (%) |
|------------------|-----------|---------|---|------------------------|-----------|-----------------------------------|
| teflon t = 250um | 28GHz Dk  | 0.00519 | 2 | 0.01037                | 2.077     | 0.499                             |
|                  | 28GHz Df  | 0.02024 | 2 | 4.047E-05              | 6.183E-04 | 6.546                             |
|                  | 38GHz Dk  | 0.00519 | 2 | 0.01037                | 2.070     | 0.501                             |
|                  | 38GHz Df  | 0.01554 | 2 | 3.109E-05              | 5.009E-04 | 6.206                             |
| Quartz t = 200um | 60GHz Dk  | 0.00519 | 2 | 0.01038                | 2.053     | 0.505                             |
|                  | 60GHz Df  | 0.01998 | 2 | 3.995E-05              | 5.500E-04 | 7.264                             |
|                  | 77GHz Dk  | 0.00519 | 2 | 0.01039                | 2.033     | 0.511                             |
|                  | 77GHz Df  | 0.01753 | 2 | 3.506E-05              | 5.340E-04 | 6.565                             |

### 產業應用

毫米波材料量測系統可提供產業在開發新材料時之特性驗證，測試內容可涵蓋產業包含PCB 基板材料、軟板、陶瓷基板、封裝材料等，並整合儀器商提供可涵蓋 28GHz、38GHz 頻段之簡易版量測解決方案。



可連接 **Keysight**、**Anritsu**、**R&S** 各廠牌網路分析儀