



## Tech Note: Comparing TTI and IR

### Thermoreflectance Thermal Imaging (TTI) & Infrared Microscopy (IR) Comparative Overview

	IR	TTI
Minimum Power	~100 mW (<10 $\mu$ W with lock-in)	500 $\mu$ W
Full Frame Time Resolution	10's ms	< 100 ns (800 ps demonstrated)
Temperature Resolution	100 mK (10 $\mu$ K with lock-in)	0.1 – 0.5 $^{\circ}$ C 1.0 $^{\circ}$ C* (6 mK demonstrated)
Spatial Resolution	~2 to 5 $\mu$ m	250 nm (top-side) 1 to 2 $\mu$ m (thru-the-substrate)
Sample Temperature	>50 $^{\circ}$ C to 70 $^{\circ}$ C	-265 $^{\circ}$ C to 500 $^{\circ}$ C demonstrated
Relative Cost	\$\$ to \$\$\$	\$ to \$\$



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### Advantages and Disadvantages

INFRARED MICROSCOPY (IR)	
Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Very good emission temperature resolution with cryogenically-cooled InSb camera</li> </ul>	<ul style="list-style-type: none"> <li>• Higher cost</li> <li>• Requires sample heating</li> <li>• Low emissivity for metals</li> <li>• Sometimes requires special sample preparation (less suitable for in situ testing)</li> <li>• Only fair spatial resolution and poor time resolution</li> <li>• Image 'blurring' unless lock-in technique is used</li> </ul>
TRANSIENT THERMAL IMAGING (TTI)	
Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Lower cost</li> <li>• Very good time and spatial resolution</li> <li>• Imaging obtained over wide range of sample temperature (sample heating not required)</li> <li>• Possible to obtain simultaneous emission and thermal images with NIR illumination source</li> </ul>	<ul style="list-style-type: none"> <li>• Only fair temperature resolution, this limits applications to samples with &gt; 1 mw power dissipation typically</li> </ul>