

# FOTRIC

— Thermal Intelligence —



手持分析更便捷 | 在线测试更长期 | 台式微距更稳定

## FOTRIC 220s

科研三合一热像仪

# FOTRIC 220s科研三合一热像仪

研发用户的测量场景复杂而多变,既有临时的检测任务,也有大量连续采样测试工作(如趋势分析、可靠性验证、破坏性测试等),且连续采样测试往往蕴藏更诱人的价值。

这让研发用户选择热像仪时常常面临两难局面:选择手持热像仪,不能应对连续采样测试工作;选择在线热像仪,灵活性又不足。

FOTRIC 220s热像仪让您不再为难:

手持分析更便捷,在线测试更长期,台式微距更稳定。





5s  
0 × 240

手持分析更便捷 | 在线测试更长期 | 台式微距更稳定

**FOTRIC 220s**  
科研三合一热像仪

## 手持更便捷

### 手机全触屏操作

全触屏APP操作界面,简单易学,开机即用。工业级设计,超万次插拔实验保证接口灵活耐用。

### 全辐射热像小视频 捕捉更多数据

手机可直接录制1000帧热像全辐射视频,温变过程实时捕捉。自定义采样速率(最快5帧/秒),没有PC也能自动采集数据。

### 照片自动关联 数据归档不费力

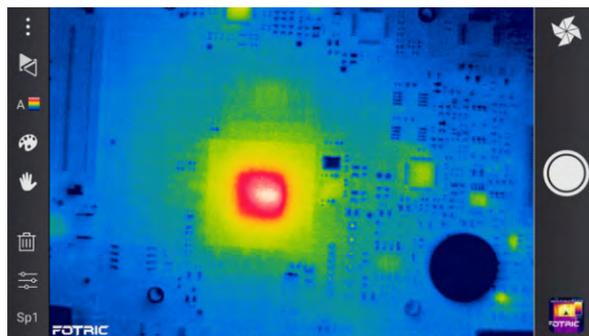
手机扫一扫,自动关联照片与设备信息,告别人工录入的繁琐、低效和错误。

### 超长续航 免去频繁充电之忧

低功耗设计赋予热像仪主机超10小时的续航能力,满足全天不间断使用要求,让用户专注工作。

### 手机直接分析热像图 使用更轻松

FOTRIC 220s系列支持热像图在本机即时分析。不仅可以分析本机拍摄热像图,更能从云端下载历史数据进行分析对比。



全触屏APP操作界面



自定义采样速率



主机10小时续航能力



手机即时分析热像图

## 灵活分区域发射率设置 专业测温参数修正

本机与PC软件都可以设置各区域不同发射率,实现不同材质单独准确测量。同时可对透过率、测试距离等进行设置,保证温度的准确性。

## 分享创造价值 APP和PC软件同时分析热像图

云架构支持远程协同工作,现场数据快速分享,远程诊断帮助问题现场解决。进度同步更新,实现零时差作业。不止手机,PC也可同步查看分析云端热像照片。



PC手机端同步分析,零时差作业

## 在线更长期

## 过硬品质 在线更长期

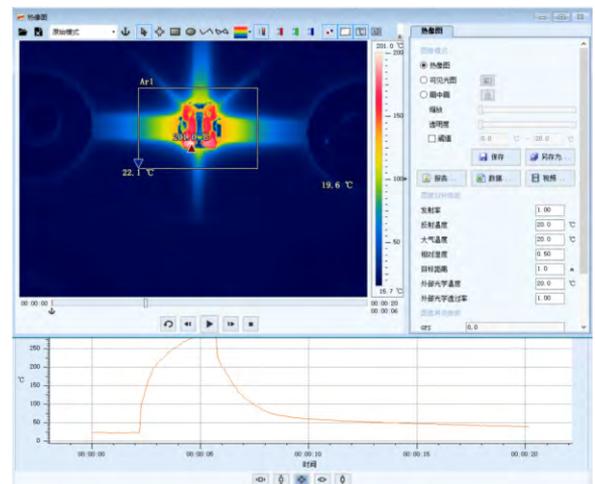
FOTRIC 220s热像仪采用价格更高,支持长期工作的电子元器件,保证热像仪以在线模式长时间运行,同时不降低使用寿命。旁路电源设计,使热像仪在外接电源模式下不间断长期运行。



高端电子元件+专业研发测试台,在线时间更长

## 全辐射热像视频流

FOTRIC 220s系列热像仪配合PC端专业的FOTRIC AnalyzIR研发软件记录全辐射热像视频,视频保存每一帧图像每个像素点的温度数据。

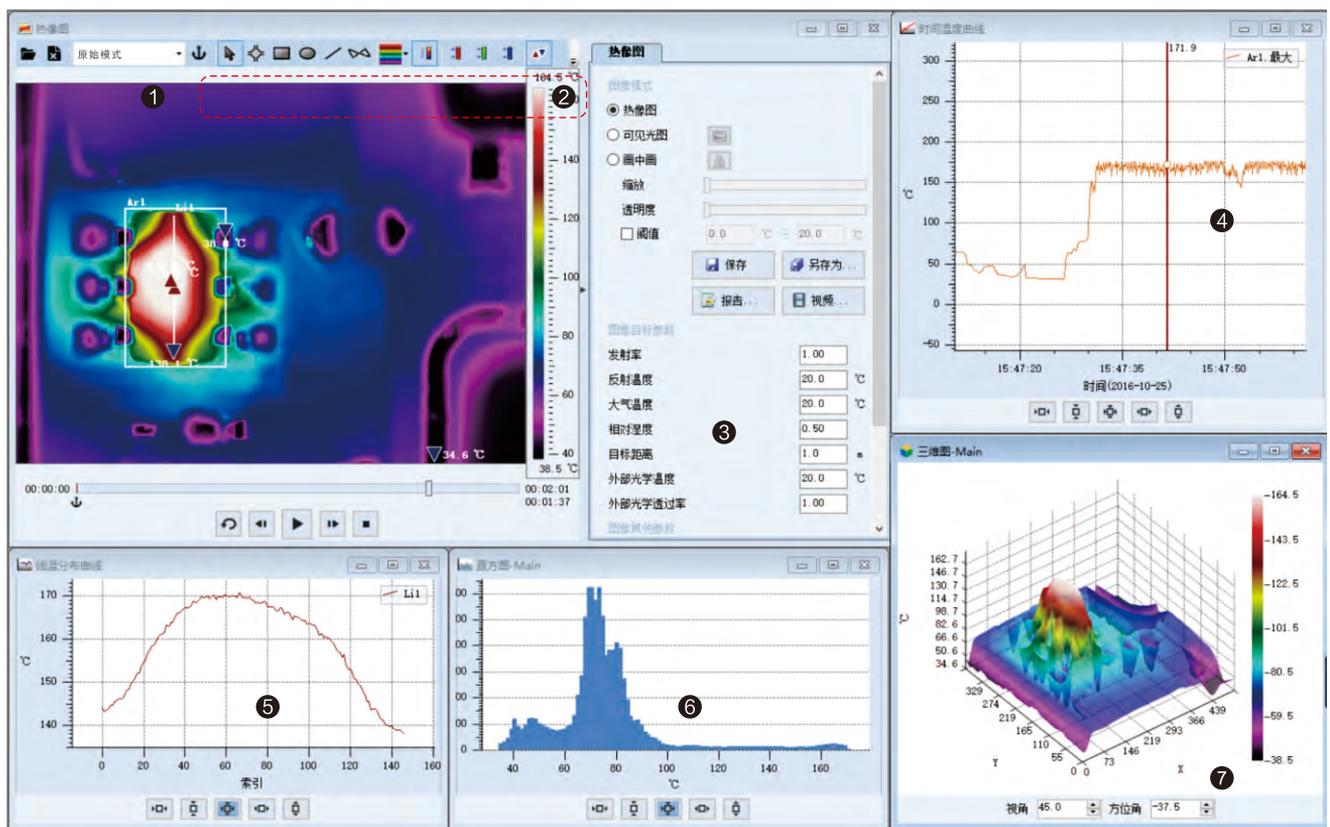


可添加任意温度点或区域,并形成温度时间曲线

# FOTRIC AnalyzIR专业分析软件

## 热像分析，绝不是单一热像图

FOTRIC AnalyzIR软件为满足研发用户使用需求而开发，从图像、温度及时间的三维角度来进行测试分析。一张图将拥有更多的细节和变化过程，比常规设备维护类热像仪的研究更深入，数据更可靠论文更漂亮。



注:

1. 原始/温差模式
2. 点、线、框、调色板、等温线等工具
3. 采样前/后温度修正，支持发射率分区域设置
4. ROI温度/时间曲线;ROI±ROI温度/时间曲线;不同视频曲线叠加对比
5. 线温分布
6. 直方图
7. 热像三维图

## 1TB超大文件,数据记录不中断

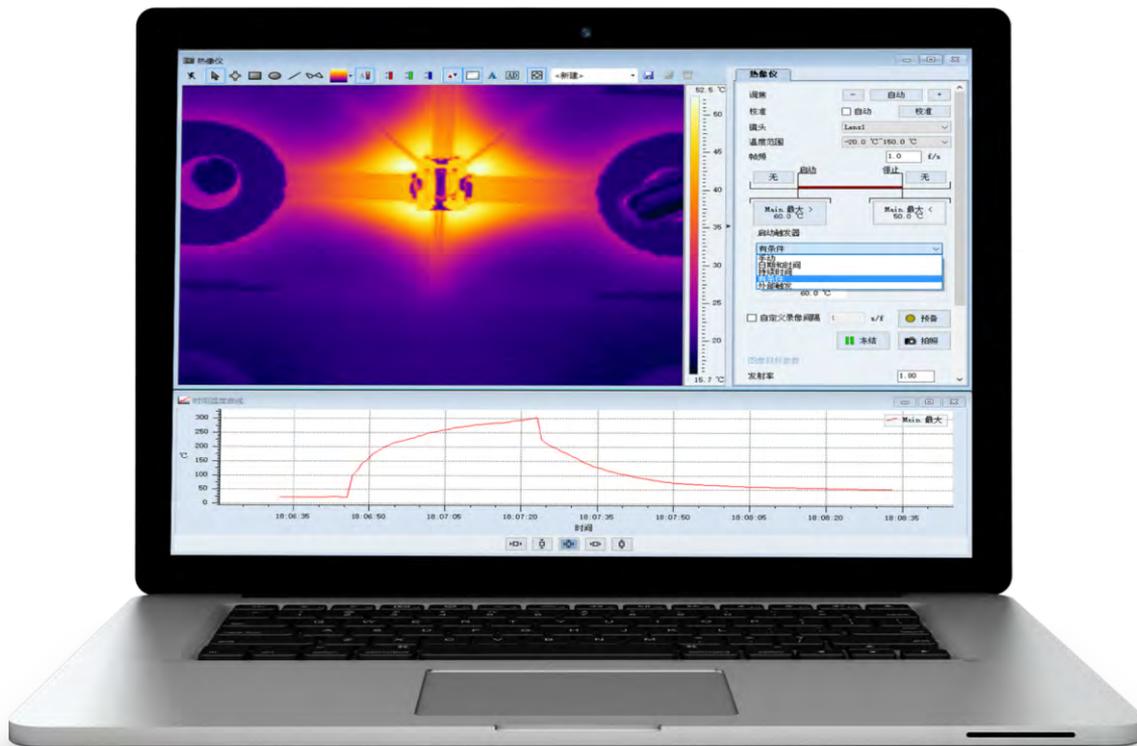
长期在线模式下采集的数据非常大。FOTRIC 220s配套软件支持最大1TB(1024GB)的单个全辐射热像视频录制,帮助研发用户记录实验过程的完整数据。

型号	Fotric 223s	Fotric 224s	Fotric 225s	Fotric 226s	Fotric 227s	Fotric 228s
在线采样帧频	5Hz	5Hz	5Hz	5Hz	5Hz	5Hz
1T单个文件采样时长	约9天	约7天	约6天	约5天	约4天	约3天

## 自动采集数据,释放人力资源

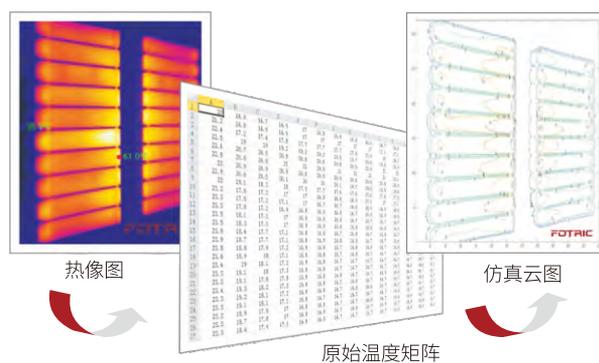
多种数据自动采集模式,便于数据记录、采集:

1. 时间触发:绝对时间触发录制、延时拍摄;绝对时间停止、相对时间停止(录制时长);
2. 温度触发:当被测物任意标记的温度超过或低于设定值,自动进行触发录制,也可设置标记在特定温度区间,自动进行触发录制;
3. 外部I/O触发:由外部I/O信号控制启动或停止录制,实现测试系统的联动控制。



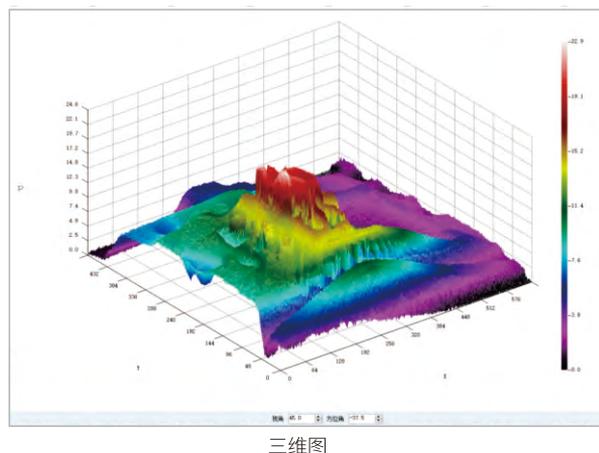
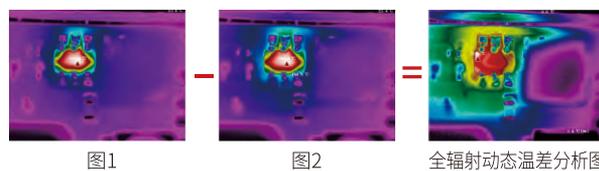
## 原始温度数据矩阵

用户可选择任意帧热像画面另存为全辐射热像图，导出该图全部像素点原始温度值的.CSV格式数据表格，这些原始数据有助用户优化算法，或是用其他软件生成仿真云图。



## 全辐射动态温差分析技术 再细微的差异也能清晰呈现

除原始温度分析外，FOTRIC AnalyzIR软件还具有温差分析模式，直观获取任意两张热像图或两个时间点的温度变化情况，分析更快速精准，报告更明了易懂。



三维图

## 画中画与画面融合

支持画中画和画面融合功能，查看画面中特定温度区域。



支持画中画功能

# 研发微距镜=独立镜头+独立标定

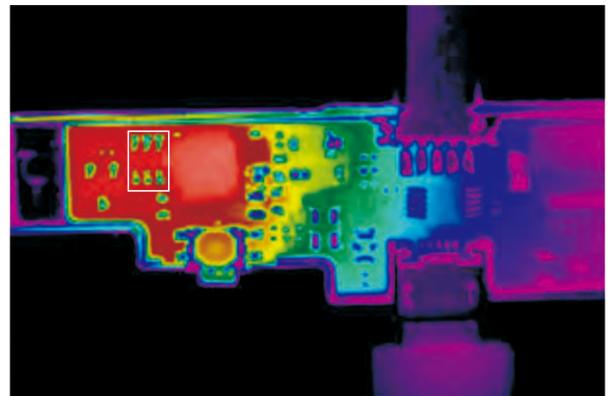
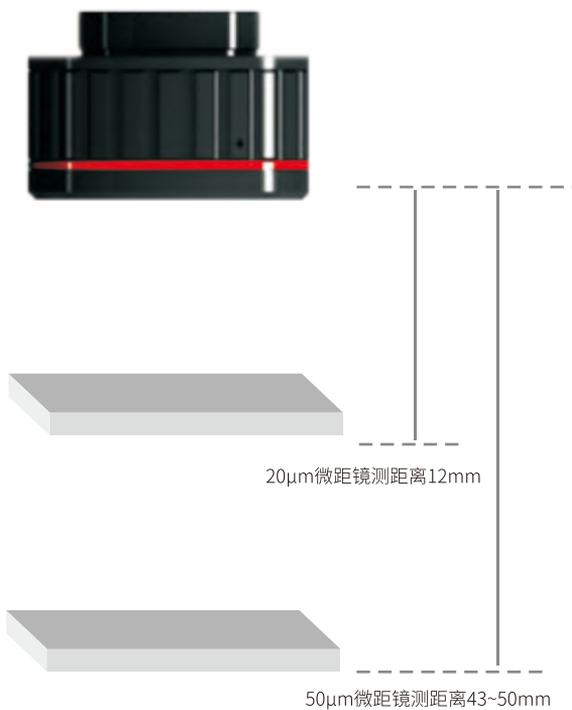
## FOTIRC 220s系列热像仪胜任20μm的微观温度分布测量

**独立微距镜：**无能量衰减，保证成像质量；而传统热像仪在标准镜头处加装倍镜会增加光衰，降低了成像质量。

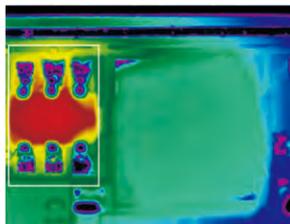
**独立标定：**FOTRIC原装微距镜与主机一对一做温度标定，测温精度得到保证。



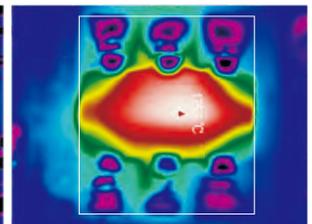
### 微距镜示意



标准镜头15cm测试距离(白色框内芯片尺寸3mm\*1.5mm)

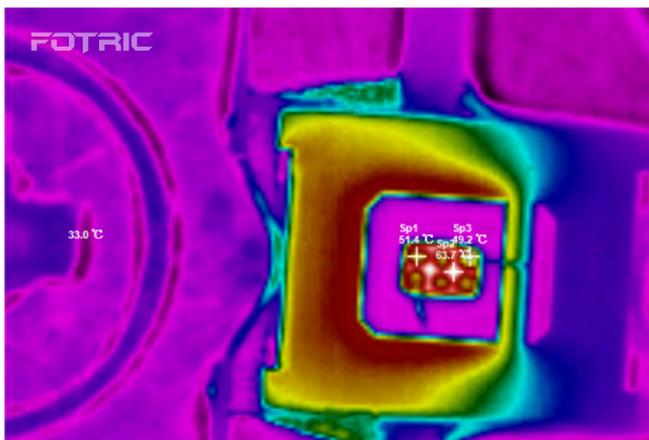


50μm微距镜



20μm微距镜

# 典型应用

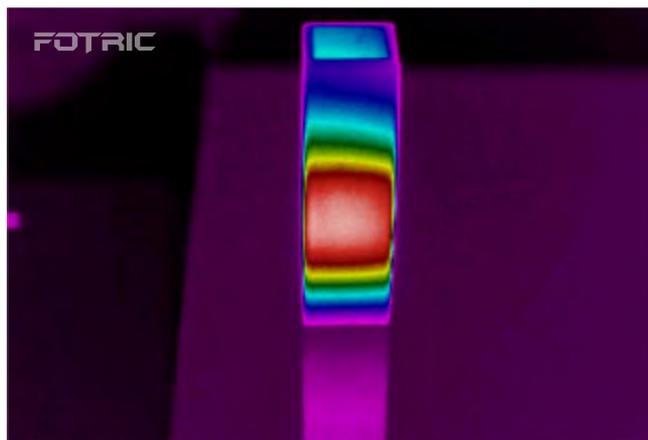


## 电子行业

未封装芯片内部温度分布测试

**测试难点:** 大多电子方面的热分布分析不是一张热像图可以解决的, 需要看到温度变化的过程, 看到整个实验的温度变化情况。

**解决方案:** 对于芯片等小目标可以使用FOTRIC热像仪搭配50微米微距镜, 甚至20微米微距镜使用研发测试台进行测试, 以解放人力, 轻松实现检测记录整个过程。通过FOTRIC AnalyzIR的在线分析功能, 可以连续检测温度变化过程, 录制后可以任意分析。

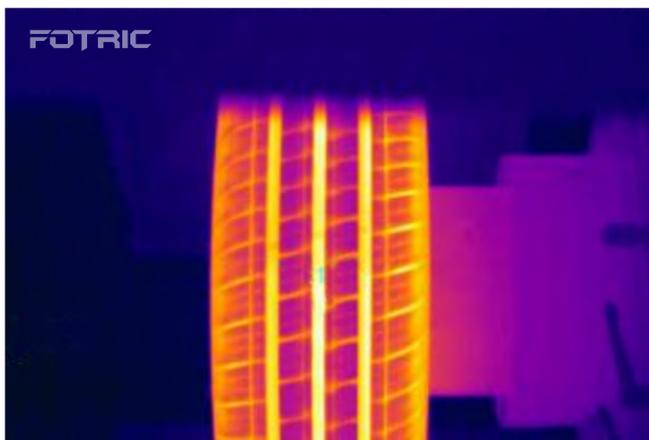


## 生物医药

靶向纳米材料

**测试难点:** 记录整个实验过程, 对比不同实验体温度变化。

**解决方案:** FOTRIC热像仪连接FOTRIC AnalyzIR软件在线分析功能实时记录整个实验过程, 利用时间温度曲线的叠加模式直接对比不同实验体的温度变化情况。

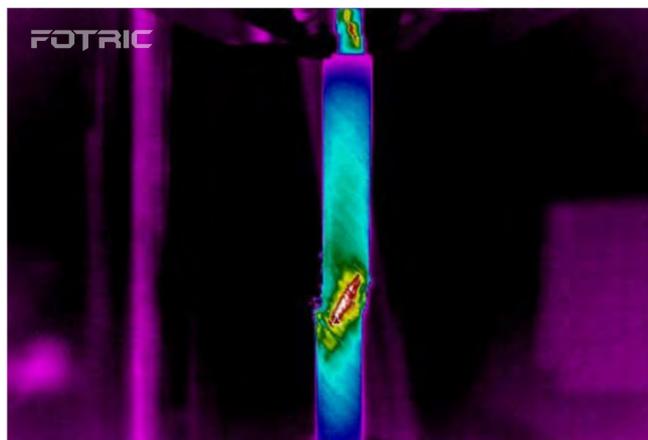


## 汽车行业

轮胎测试

**测试难点:** 轮胎需要进行冲击实验和耐久实验。冲击实验需要高帧频录制, 而耐久实验时间较长, 一般长达7-10天。

**解决方案:** FOTRIC热像仪旁路电源设计可外接电源使用而不会导致电池发热, 在线分析功能可连接PC软件录制分析, 支持自定义帧频, 进行冲击实验时可使用30Hz高帧频录制, 而进行耐久实验时可以降低帧频减少数据量, 且支持1TB单个视频录制, 满足长期录制要求。



## 材料性能

碳纤维疲劳测试

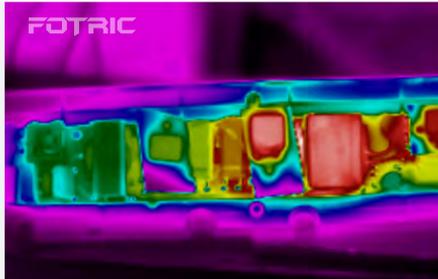
**测试难点:** 捕捉断裂瞬间, 记录温变过程用于后期分析。

**解决方案:** 断裂属于瞬间行为, 需要在线模式实时监测。使用FOTRIC热像仪, 通过FOTRIC AnalyzIR的在线分析与录制功能记录整个温变过程, 时间温度趋势分析直观展示温变情况, 温差模式便于分析温升变化。

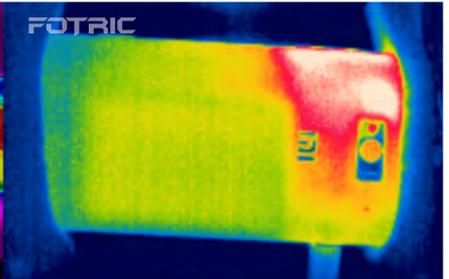
# 其他应用



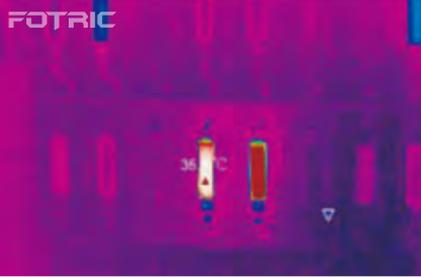
散热研究



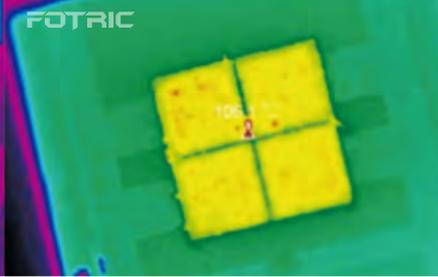
不同铜材/铝材的散热效果对比分析



电子产品入网许可皮肤舒适度测试



新能源电池



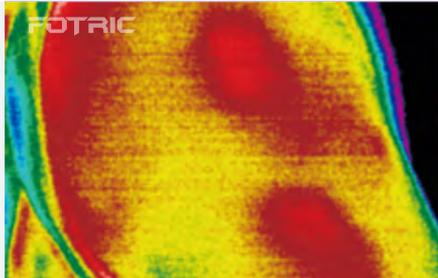
LED芯片局部热斑



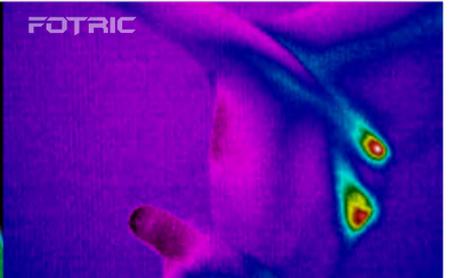
新能源与节能



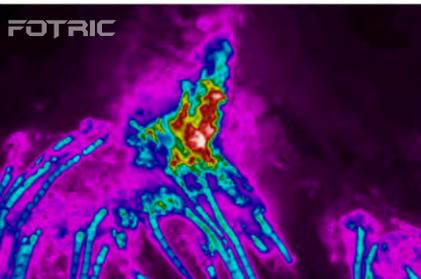
生物测试



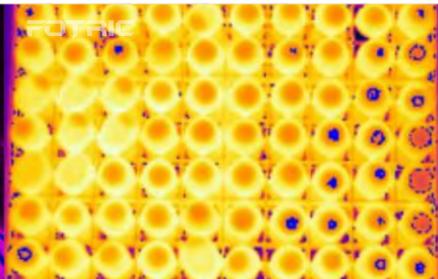
肌肉疲劳慢性僵化



长江江豚保护



火山地质活动



鸡蛋孵化活性



其他研究

# 技术参数

产品型号	Fotric 228s	Fotric 227s	Fotric 226s	Fotric 225s	Fotric 223s
<b>基本参数</b>					
红外分辨率	640×480	512×384	384×288	320×240	160×120
超像素技术	4 倍图像清晰度, 画质提升为 1280×960	4 倍图像清晰度, 画质提升为 1024×768	—		
热灵敏度 (NETD)	< 30mk@30°C	< 40mk@30°C	< 50mk@30°C		
视场角 (FOV)	28° × 21°	23° × 17°	28° × 21°	24° × 18°	19° × 14°
空间分辨率 (IFOV)	0.78mrad		1.27mrad		2.1mrad
数码变焦	1~10 倍		1~8 倍		
探测器类型	焦平面阵列 FPA, 非制冷微热量				
像元间距	17μm				
响应波段	8~14μm				
<b>测温功能</b>					
测温范围	-20~650°C (-20~150°C / 0~350°C / 200~650°C)			-20~350°C	
高温扩展	可扩展至 1200°C			-	
低温扩展	可扩展至 -40°C			-	
测温精度	±2°C或 ±2%, 取大值 (环境温度在 10~35°C时)				
高低温定位	支持				
测量模式	12 个可移动点, 12 个可移动区域, 3 条直线, 每个 ROI 可单独设定发射率		8 个可移动点, 8 个可移动区域, 1 条直线, 每个 ROI 可单独设定发射率		
修正设置	发射率、反射温度、环境温度、湿度、测量距离、透过率				
全屏发射率校正	0.01~1.0, 或从内置材料表中选择				
分区发射率校正	支持				
本机分析	有, 在热像仪手机上可直接分析拍摄的全辐射热像照片与全辐射热像视频				
颜色报警 (等温线)	有, 之上 / 之下				
测量功能报警	有, 自定义高低温报警阈值				
标签识别	识别二维码和条形码, 为热像图命名				
注释	语音和文本注释				
<b>在线测试模式</b>					
全辐射热像视频流	传输包含所有像素温度数据的全辐射热像视频流				
全辐射热像小视频	连接手机时直接录制全辐射小视频, 自定义采样和间隔				
USB	用于数据传输				
分析软件	AnalyziR, PC 端专业热像分析软件				
在线功能	实时传输全辐射热像数据至 FOTRIC AnalyziR, 实时查看温度变化趋势, 录制全辐射视频				
连续在线工作	支持外部供电长期工作				
单个文件最大容量	1TB				
<b>图像与存储</b>					
显示屏	多点触控, 5 寸电容屏				
数码相机	1200 万像素				
显示模式	热像, 画中画 (自定义位置与融合度)				
标准调色板	灰白、灰红、铁红、彩虹等 15 种				
调色板实时预览切换	当前图像 15 种调色板预览切换				
图像一致性优化	自动校准噪声 FFC/ 手动噪声校准 FFC				
图像保存模式	单一热像图, 混合图像				
图像文件格式	标准 JPEG, 含原始温度数据				
<b>电源与环境</b>					
热像仪电池类型	可充电锂电池				
热像仪电池续航时间	10 小时				
工作温度	-20~50°C				
储存温度	-20~50°C				
相对湿度	< 90%RH				

## 物理参数

防护等级	IP54
FCC	CFR 47 part 15.107; CFR 47 part 15.109
重量	约 560g
三脚架安装	UNC 1/4-20 接口可直接连接三脚架
保修期	主机 2 年, 电池 5 年, 探测器 10 年
标准配置	热像仪主机 (内置电池)、标准镜头、镜头盖、电源适配器、手机、USB 转 Micro-USB OTG 线 (左弯 / 右弯 / 长线)、USB 转 Type-C OTG 数据线、USB 转 USB 线、手腕带、入门手册、保修卡、合格证、原厂标定证书、硬质便携箱 (限 Fotric 226s、227s、228s)

## Fotric 226s/227s/228s可选镜头

	设备型号	可选镜头
	Fotric 228s	M50-228s微距镜 (标定量程0°C~150°C) M20-228s微距镜 (标定量程0°C~150°C) L17-228s长焦镜 L45-228s广角镜
	Fotric 227s	M50-227s微距镜 (标定量程0°C~150°C) M20-227s微距镜 (标定量程0°C~150°C) L14-227s长焦镜 L35-227s广角镜
	Fotric 226s	M100-226s微距镜 (标定量程0°C~150°C) M50-226s微距镜 (标定量程0°C~150°C) L15-226s长焦镜 L47-226s广角镜

注: 单个设备最多配3个镜头 (包括标准镜头与高温扩展)

# FOTRIC 220s系列可选配件

## Fotric 226s/227s/228s温度量程扩展

LT7-22xs标准镜头高温1200°C镜头

LT6-22xs标准镜头-40°C低温扩展

注:22xs代表具体产品型号,如第一项LT7-22xs标准镜头高温1200°C镜头,LT7-226s则表示226s标准镜头可扩展至高温1200°C。

## Fotric B3s万向研发测试台

万向研发测试台

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可搭配热像仪

Fotric 225s, Fotric 226s

Fotric 227s, Fotric 228s



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ARTICLE

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Photothermal therapy with immune-adjunct nanoparticles together with checkpoint blockade for effective cancer immunotherapy

Qian Chen<sup>1\*</sup>, Ligeng Xu<sup>1\*</sup>, Chao Liang<sup>1</sup>, Chao Wang<sup>1</sup>, Rui Peng<sup>1</sup> & Zhaung Liu<sup>1</sup>

ICG-R837, while the DC maturation percentages from mice treated with PLGA-ICG or free R837 (with the same dose) only increased to ~30 or ~35%, respectively. Therefore, PLGA-ICG-R837 nanoparticles showed even stronger *in vivo* immunostimulation effect compared with the same dose of free R837, although the two induced similar levels of *in vitro* DC maturation (Fig. 1d and Supplementary Fig. 3).

DCs upon maturation would secrete various types of cytokines to regulate other types of immune cells<sup>38</sup>. Thus, in the following experiment, various cytokines including interleukin 6 (IL-6) (an important marker in the activation of humoral immunity), tumour necrosis factor  $\alpha$  (TNF- $\alpha$ ) (an important marker in the activation of cellular immunity), and interleukin 12 (IL-12p70) (an important marker of innate immunity)<sup>39-42</sup> in the mouse sera after different treatment were analysed by ELISA. It was found that mice treated with PLGA-ICG-R837 showed high serum levels of IL-12p70, IL-6 and TNF- $\alpha$ , which appeared to be higher than those in sera of mice treated with the same dose of free R837 (Supplementary Fig. 4). Such observed stronger *in vivo* immunostimulation effect of PLGA-ICG-R837 than free R837 may be attributed to the sustained release of R837 from nanoparticles.

**Photothermal tumour ablation for immune system activation.** On the basis of the aforementioned experiment results,

PLGA-ICG-R837 nanoparticles designed in our system is an effective immune-stimulator. It has been reported that many other ablative tumour treatments such as hyperthermia, photodynamic therapy and cryoablation will induce strong tumour-specific immune responses<sup>43-46</sup>. Therefore, we wonder if photothermal therapy with our PLGA-ICG-R837 could trigger further enhanced immunological responses. Firstly, *in vitro* experiments verified that the residues of 4T1 breast tumour cells after NIR-induced photothermal ablation with PLGA-ICG-R837 could dramatically enhance the DC maturation, to a level much higher than that achieved by simply adding PLGA-ICG-R837 nanoparticles, or cell residues ablated by PLGA-ICG in the absence of R837 (Supplementary Fig. 2). Such results suggest that R837-containing nanoparticles could potentially act as an adjuvant to promote immunological responses of tumour-associate antigens in cell residues.

In our further *in vivo* experiment, BALB/c mice-bearing subcutaneous 4T1 tumours were intratumorally (IT) injected with PLGA-ICG or PLGA-ICG-R837 and then irradiated by an 808 nm laser at the power density of 0.5 W cm<sup>-2</sup> for 10 min. As monitored by an infrared thermal camera (FOTRIC 220s), the tumour temperature of mice injected with PLGA-ICG or PLGA-ICG-R837 under laser irradiation quickly rose to ~60 °C, which was high enough to effectively ablate tumours

PEGylated Au@Pt Nanodendrites as Novel Theranostic Agents for Computed Tomography Imaging and Photothermal/Radiation Synergistic Therapy

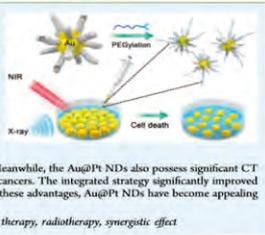
Xu Liu,<sup>1</sup> Xing Zhang,<sup>2</sup> Mo Zhu,<sup>3</sup> Guanghui Lin,<sup>4</sup> Jian Liu,<sup>1</sup> Zhufu Zhou,<sup>1</sup> Xin Tian,<sup>4,6\*</sup> and Yue Pan<sup>4,6\*</sup>

<sup>1</sup>State and Local Joint Engineering Laboratory for Novel Functional Polymeric Materials, College of Chemistry, Chemical Engineering and Materials Science, Soochow University, Suzhou 215123, China  
<sup>2</sup>Department of Radiology, The First Affiliated Hospital of Soochow University, 188, Shi Zi Road, Suzhou 215006, China  
<sup>3</sup>Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016, China  
<sup>4</sup>Printable Electronics Research Centre, Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, Suzhou 215123, China  
<sup>5</sup>Institute of Functional Nano and Soft Materials (FUNSOM), Soochow University, Suzhou 215123, China  
<sup>6</sup>School of Radiation Medicine and Protection, School for Radiological and Interdisciplinary Sciences (RAD-X) & Collaborative Innovation Center of Radiation Medicine of Jiangsu Higher Education Institutions, Soochow University, Suzhou 215123, China

Supporting Information

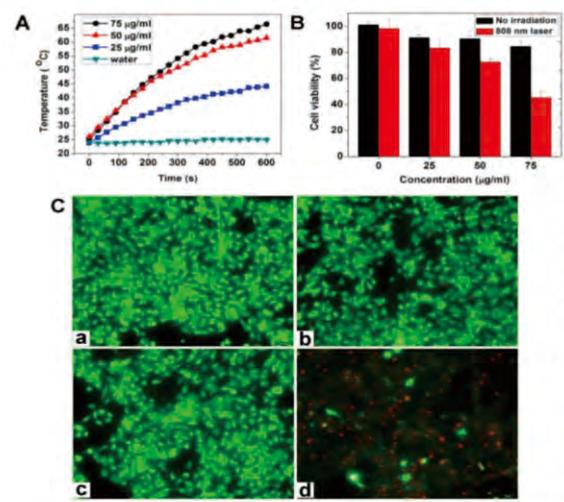
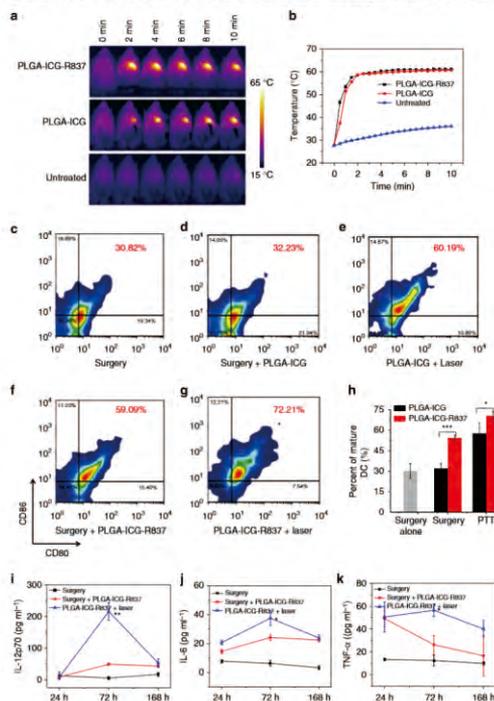
**ABSTRACT:** The integration of photothermal therapy (PTT) with radiation therapy (RT) in a single nanoscale platform is believed to have considerable potential for cancer therapy. In this work, the rationally designed PEGylated Au@Pt nanodendrites (NDs) have been developed as a novel X-ray computed tomography (CT) and PTT/RT enhanced theranostic agent for cancer therapy. The absorption of Au@Pt NDs was tuned to the near-infrared region with the growth of Pt nanobranches and thus enhances the efficacy of PTT. Furthermore, because of the high atomic number (high Z) of Au as well as Pt, Au@Pt NDs significantly enhanced lethal effects of RT by inducing a highly localized radiation dose within cancer cells. More importantly, the combination of Au@Pt ND-enhanced RT with PTT suppressed cancer cell growth more efficiently than that RT or PTT alone did, indicating a synergistic effect. Meanwhile, the Au@Pt NDs also possess significant CT imaging signal enhancement that has the potential to guide PTT/RT for cancers. The integrated strategy significantly improved CT and PTT/RT of cancer cells with mild laser and radiation. Because of these advantages, Au@Pt NDs have become appealing and effective agents for cancer theranostic.

**KEYWORDS:** Au@Pt nanodendrites, computed tomography, photothermal therapy, radiotherapy, synergistic effect



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Additionally, in comparison with rare earth and bismuth nanomaterials, Au and Pt nanomaterials have higher biocompatibility both *in vitro* and *in vivo*<sup>27,28</sup>. Moreover, Au and Pt nanomaterials also exhibit good photostability and high photothermal conversion efficiency in PTT for cancers.<sup>27,40</sup> It has also been proven that hybrid bimetallic nanoparticles exhibit optical and chemical properties better than those of single-element-containing nanoparticles.<sup>41-43</sup> Therefore, we hypothesized that the combination of Au and Pt in one nanoscale platform could be a high-efficiency and low-toxicity

**2.4. Photothermal Experiments of Au@Pt NDs.** To study the photothermal effect of the synthesized Au@Pt NDs, 1 mL aqueous solutions containing different concentrations (0, 25, 50, and 75  $\mu\text{g}/\text{mL}$ ) of Au@Pt NDs were irradiated under an 808 nm laser at a power density of 1 W cm<sup>-2</sup> for 10 min. An IR thermal camera (FOTRIC 220s) was used to record the temperature of the solutions at each time point.  
**2.5. Cellular Uptake Assays.** To determine the cellular uptake of Au@Pt NDs, the 4T1 cells were plated on a six-well plate and cultured for 24 h. Next, Au@Pt NDs (50  $\mu\text{g}/\text{mL}$ ) were added to each well for incubation in culture medium. At a determined time, PBS was used to wash the cells three times. A certain number of cells were collected to

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