Dual-Angle Imaging Camera for Determination of Dielectric Thin Film Thickness
Product Requirements Document
Professor. Jennifer Kruschwitz

Customer has reviewed and approved the final product review document.

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Document Number 00005

Revisions Level	Date
E	12-11-2017

Rev	Description	Date	Authorization
A	Initial PRD	10-23-2017	DM, YD
B	Updated specifications from first three customer meetings	11-11-2017	DM, YD
C	Updated: Responsibility and changes after first test	11-25-2017	YD
D	Updated according to project progress	12-07-2017	DM, YD
E	Updated: Responsibilities, fitness for use,	12-11-2017	DM, YD

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Statement of Advisor:

The Dual-Angle Imaging Camera is currently being developed as a spectrophotometer to determine dielectric thin film thickness. It has been shown that the dual- angle imaging camera has the potential to be a new method for thin film thickness measurement. The camera is currently developed under supervision of Dr. Jennifer Kruschwitz, a professor in the Institute of Optics, University of Rochester.

Vision:

The product is a dual-angle camera imaging system for determining dielectric thin film thickness in the RIT Microelectronics Cleanroom Lab. The product should be ready to use at the end of this project.

Environment:

As a device intended for clean room microelectronic measurements, it needs to operate in the following environment:

Temperature

15 to 35 °C – operation range

Relative Humidity

40 to 50% (no condensation) – operation range

It will operate under outlet power and 4 AA batteries for the LED light source.

Regulatory Issues:

The dual-angle camera imaging system currently does not have regulatory issues.

Fitness for use:

The dual-angle camera imaging system consists of a white 1D diffused backlight LED light source, a color camera, and lenses that are required to project LED image onto color camera with at least 10-degree angle separation between the edge and the center of the image. Spectrum of LED does not matter because it will be divided out using a bare silicon wafer to white balance the image. This will be done on MATLAB by converting image to double format in order to do math with the matrices of information.

The dual-angle camera imaging system is designed to capture two images of the specular highlight (color) from light source that is being reflected from a one-layer film with an uniform thickness of 3nm-10nm from two different angles with a uniform thickness of 0-600nm and we will need to figure out the accuracy as we go.. The difference between two angles should at least be 10 degrees.

The dual-angle camera imaging system will:

Have the camera and white LED source at a fixed angle that optimize the match rate between measured sample thin film thickness and provided sample thin film thickness

Have a CCD camera that is compatible with MATLAB and is calibrated with color checker for optimal gamma.

Have a lens system that provide images with 10-degree center-to-edge separation

Have a stage that is encapsulated or out in the open in a fixed position

Be entirely clean according to standard at RIT Microelectronic Cleanroom Lab.

Work for films on a silicon wafer.

It is desirable that:

The total cost of the dual-angle camera imaging system is under $1000.

A user-friendly GUI is developed to reduce operation difficulty.

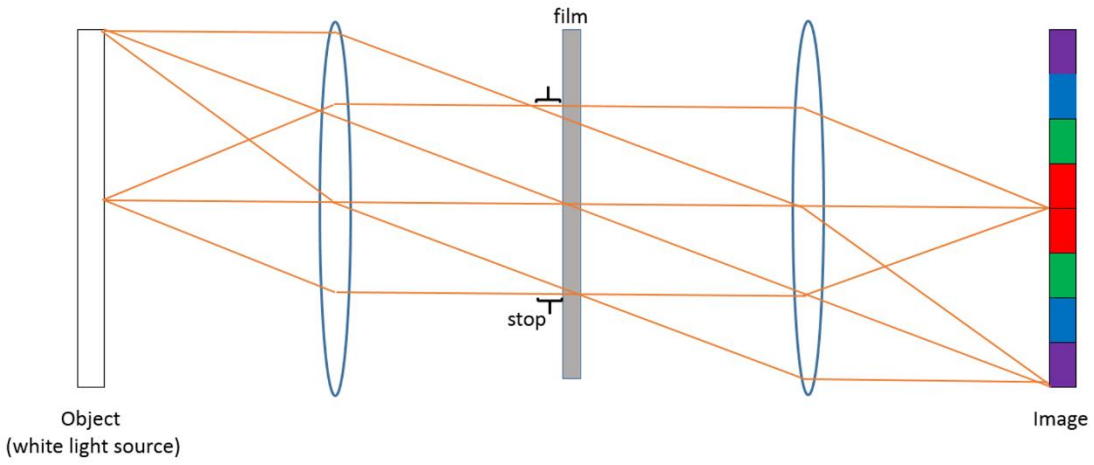
If there is time and/or team resources available:

A dual-angle camera imaging system will be integrated into a portable plug-in-and-play instrument that can be easily carried and operated with necessary instructions given.

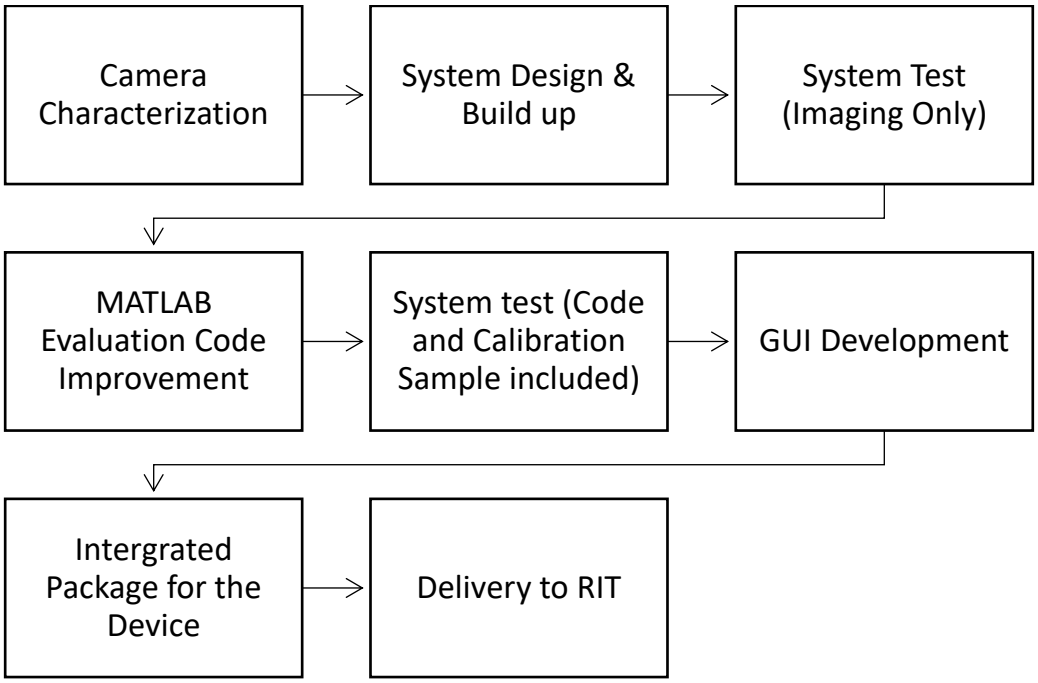
Works for films deposited on a silicon nitride wafer and silicon dioxide wafer

Specification	
White Light LED	
Vendor	Adafruit
Part No.	KWB-R3912W/1W
Ilumination Size	12*14mm
Max. Reserve Voltage	5V
Max. Forward Current	25mA
Max. Power Dissipation	90mW
Color Camera	
Vendor	Edmund Optics
Part No.	BFLY-U3-05S2C-CS
Manufactuer	FLIR
Connector	USB3.0
Pixel Depth	16 bit
Lens System	
Desgin Requirement	
Minimum image edge to center angle	10 degree
Test lens will be borrowed from the Institute	

Proposed System Design:



Project Outline:



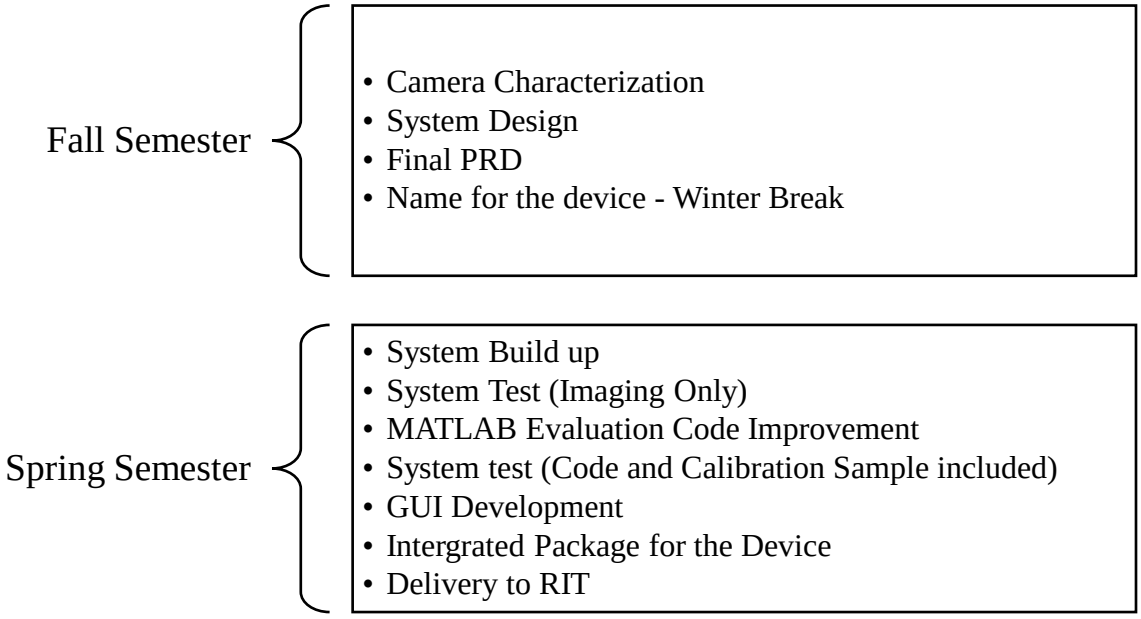
What we are responsible for:

We are responsible for the design and development of the dual-angle imaging camera including imaging test with developed MATLAB code and calibrated samples. If time permits, we are also responsible for the user-friendly GUI development and device package design.

What we are not responsible for:

We are not responsible for creating the coating reflectance database and procuring the calibration samples. These parts are performed at RIT and *should* be delivered to us by the start of spring semester, if not Professor Kruschwitz will ask UR Nano lab to fabricate the samples for us.

Timeline:



Group Member Responsibility:

Diana: Scribe, device testing, package design

Yang: Project coordinator, MATLAB code, system build up

Zheng: Customer liaison, lens system design, system build up