From: Poenar Daniel Puiu (Assoc Prof)
To: philipong@hakuto.com.sg
Subject: RE: NTU (EEE) / Hamamatsu inquiry
Date: Wednesday, 4 August 2021 2:40:00 PM
Attachments: image001.png
ReflectivityAlBare.gif
CustomFlowCellMirrors3Sides.jpg
Importance: High

Dear Mr. Philip Ong,

OK, sure, then we just wait for the reply from Japan and from Dowa.

For the FireflySci:

- I am afraid I don't have any CAD sketch and don't have any access to a CAD software. I already made them a drawing with outer dimensions included. As I clearly indicated in my text, the inner dimensions will depend on their standard wall thickness, so they can easily deduce the inner dimensions using that standard value. If they have already some existing standardized flow cell of similar dimensions close to our values then they can just use that even if the dimensions could be a bit different;
- Likewise the coating was already indicated: UV enhanced Al mirror – this is the standard name used by almost all manufacturers worldwide (with some small variations). If it makes things easier, they can consider and quote for all 3 possible variations:
    A. Quote just for the quartz flow cell with the necessary dimensions (or any standard they have closest to it) WITHOUT ANY coating;
    B. Quote for the quartz flow cell coated on 3 sides with a standard UV enhanced Al mirror, which typically consists of just an Al layer covered usually by 1 or 2 thin layers that modify its reflectivity. The layer(s) is/are to ensure reflectivity R remains reasonably high at shorter wavelengths in UV, as well as protect the Al both against oxidation & scratching. For this I also told them the specifications: the reflectivity R should be more than (or at least equal with) 80% at the wavelength of 235 nm, and should be at least that high or even higher throughout the visible range, i.e. until at least 600 nm. Usually the reflectivity is higher after the UV region because fresh unoxidized Al itself has a pretty good reflectivity in the visible range (we are **NOT interested in the IR region**). Actually, FRESH BARE Al has a very good reflectivity in UV as well; see attached graph. You can see that R>90% for all wavelengths between 200 to 600 nm, which includes our range of interest. The CATCH is that this is only for FRESH BARE aluminum and does not remain like this because because Al which will slowly oxidize, resulting in a significant loss of reflectance in the UV, and slight scattering throughout the spectrum. Therefore, it is best if aluminum has a protective dielectric overcoat deposited in the same machine, in vacuum, immediately after the deposition of the Al layer. Typically this is obtained with a thin layer of SiO_2 or other suitable/available dielectric, whose thickness has to be designed to optimize, i.e. increase (NOT decrease) the reflectivity or at least maintain it at the same level, especially in the UV part. Sometimes 2 such dielectric layers are used in order to achieve this increased/improved/maintained high reflectivity in UV and also for other roles as well (better optical matching with air, better protection against oxidations, against scratching, etc.)
    If FireflySci does have optical layer deposition equipment and optical coating specialists, I am sure they are familiar with how such a UV enhanced Al mirror can be realized.

    C. Quote for the quartz flow cell coated on 3 sides with a slightly modified mirror design. If FireflySci indeed does have optical layer deposition equipment and optical coating specialists, then it may be worth to ask them to realize a modified mirror design for the coating (see attached drawing). For the standard mirror, the topmost side has the high desired reflectivity, and the bottom side just sits on the substrate (quartz). However, for our application, it is best to have the highest reflectivity at the interface with the quartz, NOT with the air! This means that the light comes from the quartz side and also reflects back into the quartz! In optical design terms, it means that for the optical design of our mirror the "substrate" is actually air, the 1st layer is a thin SiO2 (or other dielectric) protective layer, followed by the Al layer, then the other layer(s) for enhanced reflectivity in UV-vis, and then finally the quartz, which in optical filter design terms is now the "exit medium". If it is too difficult to achieve R>80% for all wavelengths above 235 nm up to 600 nm with normal incidence at the interface with the quartz (again, light is incident from the quartz side!) then it can be designed/optimized for another angle of incidence, e.g. 45^{o}. If the FireflySci has optical coating specialists who have available the optical data for quartz, Al and of their used dielectrics at many wavelengths in the range of interest and also have the necessary optical filter design software, then this design would not take more than 30min… 1hr at the most. When I was a PhD I did have such a design software but unfortunately don't have it anymore, but I know from experience that the design in itself is not difficult, especially if they are proffesionals who know already the standard solution for a typical UV enhanced Al mirror, and whose layer thicknesses and materials may need to be tweaked a bit to re-optimize for the new situation described above (air as "substrate" and quartz as "exit medium" from which light is incident and into which is reflected back).

Finally also thank you for all the info, but can you please re-forward all the info in S$ because otherwise it is not very useful, it is exactly the same as in the website(s). Actually for the EagleEye spectrometer from OtO why is your price indicated as USD7200 when on their website is USD6800? Likewise for the LS-DH source which is USD2410 on the website?

Thank you very much once again and am looking forward for your feedback!

Best wishes,

Daniel

From: philipong@hakuto.com.sg <philipong@hakuto.com.sg>
Sent: Wednesday, 4 August 2021 11:15 AM
To: Poenar Daniel Puiu (Assoc Prof) <EPDPuiu@ntu.edu.sg>

Subject: RE: NTU (EEE) / Hamamatsu inquiry

Hi Daniel,

For the Hamamatsu products, I have requested the quote accordingly and have explain on the article required, please do allow me to get back should any further clarification is needed. The screening process will take some time, I hope we are able to revert before next week when Japan is away for their golden week holiday.

Dowa -> Please wait and allow me to revert.

Ocean Insight (*Note: accessories such as fibre will need to be purchase together with spectrometer.)

- STS-UV-L-25-400-SMA (STS Microspectrometer, 190-600nm, 25um Slit, 400 Core/1 cm SMA Input) -> USD2,100
- STS-VIS-L-25-400-SMA (STS Microspectrometer, 350-800nm, 25um Slit, 400 Core/1 cm SMA Input) -> USD2,000
- OCEAN-HDX-UV-VIS (Ocean-HDX Visible to UV-VIS Optimized Spectrometer) -> USD6,900
- QP200-2-UV-VIS (200 um Premium Fiber, UV/VIS, 2m) -> USD550
- OCEANVIEW (OceanView spectroscopy software with graphical user interface; 1 license (2 installations, accessible by download only from secure server) -> USD570

Do you require any cuvette holder? https://www.youtube.com/watch?v=XakXrpmc470 -> You can take a look on how the fluorescence measurement is done using the cuvette holder should you be interested.

FireflySci

- Customisation -> Factory have requested for wither a CAD sketch or a sketch with all dimensions indicated (inner and outer) which includes details like the coating which are required by from all end user for any customisation request.

Thank you.

Regards,
Philip Ong

From: Poenar Daniel Puiu (Assoc Prof) <EPDPuiu@ntu.edu.sg>
Sent: Tuesday, 3 August 2021 5:27 PM
To: ONG PANG KIAT PHILIP <philipong@hakuto.com.sg>
Subject: RE: NTU (EEE) / Hamamatsu inquiry

Yes, that's him!
Thanks for the provided data. I hope you can provide the others soon and also please inquire Firefly about the custom cuvette.
Thank you!
Daniel

From: philipong@hakuto.com.sg <philipong@hakuto.com.sg>
Sent: Tuesday, 3 August 2021 5:20 PM
To: Poenar Daniel Puiu (Assoc Prof) <EPDPuiu@ntu.edu.sg>
Subject: RE: NTU (EEE) / Hamamatsu inquiry

Hi Daniel,

Thank you for sharing. Can I confirm if Professor S.A. Synder you have mentioned is from Civil & Environmental Engineering https://www.ntu.edu.sg/cee/about-us/our-people/faculty/rp00731? I try to explain and justify with Hamamatsu accordingly.

Please refer to the following budgetary price for your reference purpose:

OTO Photonics (Please refer to the attached data sheet for your reference purpose) *Note: accessories such as cuvette and fibre needs to be purchase together with spectrometer.

- UVvis-TEC spectrometer / EagleEye model -> EE2063 - USD7,200/unit
- Deuterium-Halogen Light Source (LS-DH) -> LS-DH-2 – USD2,700/unit
- 2 optical fibers OF-600-100-UVS, again also with any necessary coupling lens & control/analysis software if needed.
    - OF-600-100-UVS (optical fibre) – USD350
    - CH-4W (4-way cuvette holder set) – USD390
    - CVT-QAZ (Quartz square cuvette) – USD150

FireflySci (*Note: There will be additional freight charge + handling fee of USD150)

- 48UV10 -> USD320/pce
- 501UV10 -> USD340/pce

Regards,
Philip Ong

From: Poenar Daniel Puiu (Assoc Prof) <EPDPuiu@ntu.edu.sg>
Sent: Tuesday, 3 August 2021 4:56 PM
To: ONG PANG KIAT PHILIP <philipong@hakuto.com.sg>
Subject: RE: NTU (EEE) / Hamamatsu inquiry

Yes, that is correct, the list & details are OK.
Since we don't even a complete project proposal yet, let alone an on-going approved project, obviously there has been no work done

and hence no publication! But the 2 attached paper is authored by prof. Snyder, who is now a prof. in NTU and who will also participate in the project. I hope this is OK.

Thank you once again and am looking forward for your quotation(s).

With best wishes,

Daniel

From: philipong@hakuto.com.sg <philipong@hakuto.com.sg>
Sent: Tuesday, 3 August 2021 4:36 PM
To: Poenar Daniel Puiu (Assoc Prof) <EPDPuiu@ntu.edu.sg>
Cc: gregoryquek@hakuto.com.sg; kelvintee@hakuto.com.sg
Subject: RE: NTU (EEE) / Hamamatsu inquiry

Hi Daniel,

Thank you for getting back with the details and information. I have summarised the details accordingly and also for your requested products below. Regarding the written article as requested for Japan export screening. Do you have any article which has been written by either yourself or from any one in NTU EEE relating to this application? This is usually requested by Hamamatsu for their screening process.

- Model Number: S1227-1010BQ, S12698-02, S1337-21, S4114-46Q, S5973-01, S12271, S9295, S3477-04, S8553, S15249
- Quantity: 2-6pcs each
- Application: Water quality assessment and monitoring using UV absorption as well as fluorescence.
- End User: NTU
- End User Country: Singapore
- End User Website: https://www.ntu.edu.sg/eee

Ocean Insight

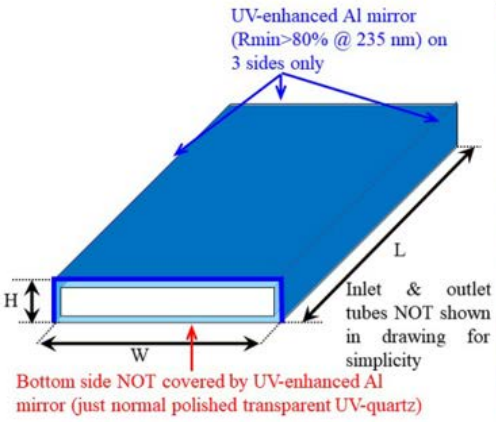
- STS-UV, STS-VIS and
- OCEAN-HDX-UV-VIS, including 2 coupling optical fibers and any necessary coupling lens & control/analysis software if needed.

OTO Photonics

- UVvis-TEC spectrometer
- EagleEye model EE2063,
- Deuterium-Halogen Light Source (LS-DH), and
- 2 optical fibers OF-600-100-UVS, again also with any necessary coupling lens & control/analysis software if needed.

FireflySci

- 48UV10
- 501UV10
- A custom-made flow cell, as shown in the drawing in the left attached image below.
    - The dimensions are: L= 50 mm, W = 25 mm; H = 5?....8? mm. The wall thickness can be chosen as dictated by the fabrication considerations. The H value will probably also be dictated by manufacturing practical considerations, because the inside chamber will have a height h = H-2t, where t is the thickness of the quartz material which obviously cannot be reduced below a certain minimal value, which I am not sure what would be in their case: 1.5 mm? If we assume 1.5 mm to be indeed the minimal quartz wall thickness value then I believe that a minimal overall height of ~6…7 mm is feasible. As is shown in the drawing, ideally we would like 3 of the lateral walls (all of which normally would be smoothly polished and transparent) to be (after polishing) covered with an UV-enhanced Al coating which can serve as a good quality mirror for both most of the UV and visible ranges. For such mirrors usually the critical part is extending the reflectivity in the UV, hence the indicated value of minimal reflectivity for the coating of Rmin>80% @ the wavelength of 235 nm, because usually the reflectivity just gradually increases at larger wavelengths and remains relatively high throughout the visible range. The flow cell can be made either like a 501 type (i.e. with the inlet/outlet colinear with the flow cell itself), or as a 48 type (i.e. the inlet/outlet will be normal onto one facet, in this case obviously the non-covered facet, but in this case clearly the entire length of the cell will need to be increased to include the size necessary for the inlet & outlet themselves), which is considered to be best for manufacturing and assembly (see next).
    - Finally, the price in the quotation should be for a final product that should include not just the custom flow cell but also its immediate fluidic connections to the inlet & outlet. In other words, it should look similar to the item shown in the right attached image below, i.e. it is better if they can do also do the coupling of inlet & outlet to tubing themselves so that we do not damage them or the delicate quartz flow cell and we can easily use it directly and connect it to any other tubing as required (and this way the inlet/outlet are also better protected during shipping & subsequent handling). The dimensions (LWH) are not very critical. If it is considered that for handling and safety considerations -e.g. for proper subsequent polishing without breaking it apart, and/or to be able to properly screw tightly the metal connectors to the tubing at the end- at least one of the initial sizes needs to be modified (e.g. H needs to be increased, say to a minimal value of 9 mm), then sure, no problem.



DOWA

- UF1VL-1H321 & UF4VL-1H321
- 308-FL-02-G02 & 340-FL-02-G02
- Any LEDs with emission at shorter wavelengths, e.g. 280 nm and 235 nm.

Thank you.

Regards,
Philip Ong

From: Poenar Daniel Puiu (Assoc Prof) <EPDPuiu@ntu.edu.sg>
Sent: Tuesday, 3 August 2021 3:45 PM
To: ONG PANG KIAT PHILIP <philipong@hakuto.com.sg>
Cc: QUEK SEOW BENG GREGORY <gregoryquek@hakuto.com.sg>; KELVIN TEE CHENG KAI <kelvintee@hakuto.com.sg>
Subject: RE: NTU (EEE) / Hamamatsu inquiry
Importance: High

Dear Mr. Philip Ong,

Thank you for your quick reply! I am a bit familiar with Hakuto, actually Mr. Gregory Quek may remember me from the past when I bothered him a few times for various quotations.

Let me quickly address you questions. First, attached you have the filled in declaration file, with attached papers as required about clarifying the application/topic of our proposal. Second, as I also stated there, please allow me to highlight that at this moment I need only the cost information/quotation not a delivery of devices because I am working at the project proposal and I need to estimate the total budget. For this I need to compare not only the specs of various devices but also their costs in order to select the most suitable one(s) for the project, so right now the question of usage of the devices is irrelevant. IF the project will ultimately be approved, then of course the question of delivery will become relevant, and in that case certainly I will contact you once we will need device(s) to make the setup(s).

The project proposal itself is about water quality assessment and monitoring using UV absorption as well as fluorescence.

- Quantity: The setup may need 2 detectors, one for UV absorption and one for fluorescence, but probably we may need to do a few versions of setups, so maybe a safer estimation of most probable need would be a possible order of 6 pieces. However, this will not be for ALL the devices I inquired about, but only for 2 or 3 of them which ultimately will be selected as optimal. Once the project will be approved and the design clarified, I will contact you again when delivery will be needed.
- Application: Right now no application, only budget estimation for a project proposal. The project proposal itself is about water quality assessment and monitoring using UV absorption as well as fluorescence (see attached papers).
- End User: NTU
- End User Country: Singapore
- End User Website: NTU/EEE website

Since you mentioned you are also distributor for other companies I also am interested in the following products, so I hope it is possible you can also give me quotation(s) for these products:

- *From Ocean Optics* (which now is Ocean Insight – BTW your **link is not correct**: any browser I use gives a warning that the site is not secure): the spectrometers STS-UV, STS-VIS and OCEAN-HDX-UV-VIS, including 2 coupling optical fibers and any necessary coupling lens & control/analysis software if needed.
- *From OTO Photonics*: the UVvis-TEC spectrometer EagleEye model EE2063, Deuterium-Halogen Light Source (LS-DH), and 2 optical fibers OF-600-100-UVS, again also with any necessary coupling lens & control/analysis software if needed
- *From FireflySci*: they have **quartz** flow cells and I am interested in a few. I would like to ask you to please kindly give me the prices of the following flow cells (ALL made of **UV quartz**) in a quotation:
  - 48UV10
  - 501UV10
  - A custom-made flow cell, as shown in the drawing in the first attached jpg image. The dimensions are: L= 50 mm, W = 25 mm; H = 5?....8? mm. The wall thickness can be chosen as dictated by the fabrication considerations. The H value will probably also be dictated by manufacturing practical considerations, because the inside chamber will have a height $h = H-2t$, where t is the thickness of the quartz material which obviously cannot be reduced below a certain minimal value, which I am not sure what would be in their case: 1.5 mm? If we assume 1.5 mm to be indeed the minimal quartz wall thickness

value then I believe that a minimal overall height of ~6…7 mm is feasible. As is shown in the drawing, ideally we would like 3 of the lateral walls (all of which normally would be smoothly polished and transparent) to be (after polishing) covered with an UV-enhanced Al coating which can serve as a good quality mirror for both most of the UV and visible ranges. For such mirrors usually the critical part is extending the reflectivity in the UV, hence the indicated value of minimal reflectivity for the coating of R_{min}>80% @ the wavelength of 235 nm, because usually the reflectivity just gradually increases at larger wavelengths and remains relatively high throughout the visible range. The flow cell can be made either like a 501 type (i.e. with the inlet/outlet colinear with the flow cell itself), or as a 48 type (i.e. the inlet/outlet will be normal onto one facet, in this case obviously the non-covered facet, but in this case clearly the entire length of the cell will need to be increased to include the size necessary for the inlet & outlet themselves), which is considered to be best for manufacturing and assembly (see next). Finally, the price in the quotation should be for a final product that should include not just the custom flow cell but also its immediate fluidic connections to the inlet & outlet. In other words, it should look similar to the item shown in the last attached jpg image, i.e. it is better if they can do also do the coupling of inlet & outlet to tubing themselves so that we do not damage them or the delicate quartz flow cell and we can easily use it directly and connect it to any other tubing as required (and this way the inlet/outlet are also better protected during shipping & subsequent handling). The dimensions (LWH) are not very critical. If it is considered that for handling and safety considerations -e.g. for proper subsequent polishing without breaking it apart, and/or to be able to properly screw tightly the metal connectors to the tubing at the end- at least one of the initial sizes needs to be modified (e.g. H needs to be increased, say to a minimal value of 9 mm), then sure, no problem.

- *From DOWA*: I would like to know the prices for the following devices:
  - UF1VL-1H321 & UF4VL-1H321
  - 308-FL-02-G02 & 340-FL-02-G02
  - Do they have LEDs with emission at shorter wavelengths, e.g. 280 nm and 235 nm??

Thank you very much for you time and consideration and I am looking forward for your feedback!

With best wishes,

Daniel

From: philipong@hakuto.com.sg <philipong@hakuto.com.sg>
Sent: Tuesday, 3 August 2021 11:28 AM
To: Poenar Daniel Puiu (Assoc Prof) <EPDPuiu@ntu.edu.sg>
Cc: gregoryquek@hakuto.com.sg; kelvintee@hakuto.com.sg
Subject: NTU (EEE) / Hamamatsu inquiry

Dear Daniel,

Thank you for the interest for Hamamatsu's products, I am glad to follow up from here. May I take this opportunity to introduce Hakuto Singapore www.hakuto.com.sg. We are 100% Hakuto Japan www.hakuto.co.jp owned Trading company and we are the authorized distributor of Hamamatsu Photonics K.K.(HPK) products.

As per of mandatory request by Japanese export control, user's declaration is required before official quotation. The reason is to avoid mass destructive weapon development. Please kindly provide the following information highlighted in red as some of the customer overlooked and quotation was delayed due to in sufficient information. We would also need your kind assistance to fill up the attached IEP form. Do take note to provide us with reply on Question 5.5 (to provide an article written by yourself or anyone from the same department relating to the application) in attached IEP form as some of the customer overlooked and quotation was delayed due to in sufficient information.

I apologise for any inconveniences caused as this is any requirement from all end user.

- Model Number: S1227-1010BQ, S12698-02, S1337-21, S4114-46Q, S5973-01, S12271, S9295, S3477-04, S8553, S15249
- Quantity:
- Application:
- End User:
- End User Country:
- End User Website:

In the meantime, we are also the authorized distributor of Various Major makers of Photonics companies such as:

- Colorimeter / Spectrophometer / Biophotometer / TOC Analyzer / Microwave digestion
  - 3nh
  - Metash
- Spectrometers
  - Ocean Optics
  - OTO Photonics
- Smell sensor
  - Aryballe Technologies
- Spectral Sensors
  - AMS
- Cuvettes
  - FireflySci
- LEDs
  - Dowa

Looking forward to your information.

Thank you.

Regards,

Philip Ong
Chief Sales Engineer

Hakuto Singapore Pte Ltd
151 Lorong Chuan, #06-07A, Lobby G,
New Tech Park Singapore 556741
Tel: (65) 6745 8910
Email: philipong@hakuto.com.sg
http://www.hakuto.com.sg

[Inquiry]

Dear Lady/Sir,
My name is Poenar Daniel and I am an Assoc. Prof. in the School of Electrical & Electronical Engineering (EEE) of the Nanyang Technology University (NTU), Singapore.
I am now working on a project proposal for whose budget configuration I need to quickly gather quotations for the required materials & consumables.
I would like to ask you to please kindly provide me a quotation with the costs for the following products:
S1227-1010BQ
S12698-02
S1337-21
S4114-46Q
S5973-01
S12271
S9295
S3477-04
S8553
S15249
Please kindly also include in the quotation the cost of packaging & shipping.
Thank you for your help and am looking forward for your quick feedback !
With best wishes,
Poenar Daniel

[Customer Information]

Email:epdpuiu@ntu.edu.sg
First Name:Daniel
Last Name:Poenar
Organization name:NTU
Department:EEE School
Street:50 Nanyang Avenue
City:
State or province:
Postal/ZIP code:
Country:SG
Phone:+65 6790 4337
Fax:
