Prevent Global Warming, Reduce CO2 Emissions
Room Temperature Cured Thermal Insulating Glass Coating Solution
New Business Opportunity in Autos/Realty

Glass Coating that Cuts IR and UV
HOT GUARD & HOT GUARD SC

Sketch & Co., Ltd.
Advanced Nanotech Thermal Glass Coating

1. Target of R&D
Thermal Glass Coatings were initially developed over ten years ago by Sumitomo Metals in cooperation with Shimada, now an officer of Sketch, who received a request from NTT’s affiliate NTT-AT to develop a product in response to complaints that telephone booths with glass on all four sides became excessively hot in the summer. The resulting product was the only thermal insulating glass coating that cures at room temperature. The earliest versions of this product were based on ruthenium which had the primary effect of blocking near infrared radiation, but also blocked most ultraviolet radiation as well. Because the version of ruthenium employed in the original formulations would readily produce imperfections in the surface, application was limited to professionals who had received adequate training. Moreover, the applied cost per square meter ranged from JPY 15,000 to JPY 20,000 because of the high distributorship fees charged to cover the development costs. As a result of high prices, the product did not sell widely. In November 1999, however, Sketch & Co., Ltd. developed a transparent thermal insulating glass coating based upon ATO (antimony tin oxide) to block both near and far infrared radiation that was not limited to reducing heat during the summer months, but also reduce heat escape during winter and was effective in reducing the condensation that results from temperature disparities. This new product could be applied by anyone in a simple coating process that did not yield many surface imperfections and could be applied for JPY 6,000 ~ 8,000 per square meter. Throughout the world, builders are beginning to deal with the need for windows that function as a more effective barrier to heat loss and gain in order to comply with the carbon dioxide emission restrictions of the Kyoto Agreement reached on February 16, 2005. In response to this Sketch has exhibited this glass coating which employs ATO developed by Mitsubishi Materials and which surpasses solar films in functionality at GlassBuild America in Atlanta in September 2005 and at the Construction Materials Show in Beijing in March 2006. Building on our base in Japan, sales are now expanding in the China and Southeast Asia.

1. Better thermal performance than films with twice the longevity and at half the price.
2. Does not generate the reflective pollution of reflective glass and because of its high transparency it does not interfere with the warmth of the winter sun.
3. It will not oxidize like low-e glass does and can be applied to single pane windows.
4. The primary market advantage is that this is a liquid coating that does not require substantial investment and can be applied by anyone to existing buildings.

2. The Primary Limiting Factor in Making Thermal Insulating Window Glass is Cost
In this era of global warming where the earth gets hotter by the year and glass covered skyscrapers grow thick like forests as testimony of the economic growth of each country, various insulating glass products are used to improve the energy efficiency of these buildings
including heat absorbing glass, reflective glass, pair glass, low-e glass and insulating film. These products from glass manufacturers range from JPY 15,000 per square meter to JPY 30,000 per square meter (or about $15-$30 per square foot) or more and for existing non-energy efficient glass, the only alternative seems to be costly replacement with more energy efficient windows. Moreover, films tend to have a short life-span of only 5-10 years and at JPY 15,000 per square meter (or about $15 per square foot), applying film can be a costly investment.

Converting existing windows to make them thermal insulating with a single inexpensive coating of JPY 6,000〜8,000 per square meter (about $6〜8 per square foot) can only be done with Sketch’s thermal insulating coating. Not only does IRUV Cut Coat™ provide impressive thermal functionality, it also blocks harmful ultra violet radiation.

3. Cost Comparisons – the Top Factor

Options for converting existing normal glass to thermal insulating glass:

1. Reflective glass and low-e glass. The glass alone costs three times that of normal glass and when you factor in installation charges, the cost becomes prohibitive unless installed as part of new construction. Even as a part of new construction, glass costs for energy efficient windows can reach JPY 20,000 too JPY 30,000 per square meter. With existing windows, the frames also have to be replaced, further increasing the price disparity.

2. Application of Solar or Insulating Films. Even the cheaper films cost JPY 2,500 per square meter and 3M offers one that runs JPY 4,000 per square meter which means material costs alone can run JY 6,000〜8,000 per square meter. When application costs are included, the minimum costs ranges from JPY 10,000 per square meter or JPY 12,000 for films with superior performance. Films often have to be changed every 5-10 years.

3. By far the least expensive glass coat. With product costs of JPY 1,500 per square meter and application costs of another JPY 1,500 allows for a profit of JPY 3,000 when the customer pays JPY 6,000〜8,000 per square meter. Certainly application is simpler than window replacement. Product costs are lower than for films and application is simpler than window replacement. This coating will last 10-20 years. Thus, from every perspective, our thermal insulating glass coat is superior. We have now introduced a JPY 3,000 per square meter for applicators in the world’s largest glass and construction market – China.
4. Functionality of the various thermal glass coatings.
Our thermal insulating glass coatings have two product offerings. The first all-purpose product reduces IR and UV radiation while the second product reduces only IR and targets energy savings on areas such as north-facing windows.

<table>
<thead>
<tr>
<th>Product</th>
<th>Temperature inside window</th>
<th>Temperature difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Normal Glass</td>
<td>55°C</td>
<td>—</td>
</tr>
<tr>
<td>b. HOT GUARD Coat</td>
<td>40°C</td>
<td>7°C~</td>
</tr>
<tr>
<td>c. HOT GUARD SC Coat</td>
<td>45°C</td>
<td>~10°C</td>
</tr>
</tbody>
</table>

5. Reduces Condensation as much as 50%.
Our thermal insulating glass coats are effective in winter in blocking the heat escaping through the window and substantially reduce the temperature disparity between the window and the inside of the room thereby reducing condensation. No longer will there be cold drafty spots next to a window. Coating a single pane of normal glass gives it greater thermal performance than pair glass and condensation is reduced through heat absorption. Low-e pair glass now costs JPY 30,000 or more per square meter. If double pane glass windows are coated, the thermal performance equals that of low-e glass and the cost is 50% less. The fully applied cost of JPY 6,000~8,000 per square meter is so much less than the JPY 30,000 ~ JPY 40,000 cost of replacing with low-e windows that there is no comparison.

6. The Problems with Reflective Glass.
The best energy savings come from cutting both IR and visible light. The most popular product with the ability to cut both has been Reflective Glass or Tinted Glass. With reflective glass, the entire building surface becomes a mirror. By reducing visible light transmission to 40% or less and reflecting substantial percentages of infrared radiation, these glass products were essential for highrise buildings. In recent years, these reflective glass products have begun to be viewed as a major environmental problem in municipal areas. First, there is the annoying glare that reflects off mirror-covered buildings, but there is also the absorption of the reflected heat by the ground during the day only to re-radiate that heat at night creating a heat island effect in larger cities.

In winter, on the other hand, the sun’s warmth and energy from visible light is kept out of the building’s interior causing a greater cooling load, increasing carbon dioxide emissions. As a result, the market for low-e glass, double-pane glass and transparent insulating films are growing strongly.
7. The Advantages of Thermal Insulating Glass Coating that Cures at Room Temperature.
The cost effective alternative to applying solar films to existing glass windows is the application of Sketch's new glass coatings. There are several methods of application. The first is simple enough for anyone to apply – the sponge/bar method (a method using special sponges and metal sponge holders or bars). The sponge/bar method may seem primitive, but this revolutionary can be applied without expensive equipment or source of electricity and generally with only a single day of training. This coating does not have the oxidation concerns associated with soft low-e glass. Waste is also reduced by permitting an applicator to use just that portion of the product necessary to cover the surface area of the window. A pair of experienced applicators working together should be able to apply 50 square meters a day while a team of three applicators should coat as much as 100 square meters. That reduces the price of this coating to ¼ to 1/5 of the cost of low-e pair glass.

8. Ease of Application
IRUV Cut Coat has very good leveling properties. It will level for a full five minutes after application. Within 30~40 minutes, the coated surface will dry to the touch and will not longer permit fingerprints. Within 24 hours, the coat will achieve a hardness of 3H. Thereafter, the coating will endure for 10 or more years at a hardness of 4H.

Because this coating is applied to the interior side of a window, generally a stepladder is all that is necessary for this simple application.

Application is possible without regard to weather, time of day or day of the week. IRUV Cut Coat can be easily applied by anyone with the liquid coating and the specialized sponge.

9. Application Method
IRUV Cut Coat is a room temperature cured coating that hardens by mixing two liquids – the primary liquid and a customized hardener. The steps in the application process can be summarized as follows: (a) prepare the glass surface by buffing it with a grease remover and wiping it completely clean of grease or buildup; (b) prepare the window area by applying masking tape (and plastic wrap) to the window frame or other areas to be protected from the liquid coating; (c) prepare the customized sponge by covering with plastic wrap a gutter-shaped container, pouring the liquid into the container and then dipping the sponge into the liquid until the sponge has fully absorbed the liquid; (d) starting about 20cm below the top of the window, touch the sponge evenly to the window without causing drips and in a smooth, even motion move the sponge up to the top of the window and then all the way to the bottom of the window; (e) put additional liquid on the sponge by dipping it in the gutter-like container and repeat the application just to the side of the previous application with only 10~20 centimeters of overlap. Be careful not to stir up any dust because the surface will not be dry to the touch for 30 minutes.
10. **Price for Applied Coat (Attempting to break the JPY 6,000~8,000 per square meter level)**

Today, NTT-AT is marketing insulating coats at JPY 15,000 per square meter. Even coats that only block UV and have no insulating effect can cost JPY 8,000 per square meter. We believe that these products are more appropriately priced in the range of JPY 6,000~8,000 per square meter when sold in the construction industry given the long-term lack of growth Japan’s economy has experienced. The coating liquid and consumable materials should cost about JPY 1,500 per square meter and another JPY 1,500 per square meter of labor for a total cost of JPY 3,000 per square meter, leaving a substantial profit margin when sold for JPY 6,000~8,000 per square meter installed.

11. **This product is especially suited for low labor cost countries – combining high-tech materials with low-tech application that requires only a day of training.**

For those developing countries located in the warmer regions of the globe close to the equator, the question is how cheaply existing windows can be converted to energy efficient ones. For existing buildings, the primary competition is with solar films. Most films are produced in the US or Japan at a price of JPY 3,000~5,000 per square meter. Typically, that results in an installed price of JPY 10,000 or more per square meter. Because the wholesale price of the liquid coating of JPY 800~1,000 is half that of films, the price to applicators can be set at JPY 2,000 and still be considerably cheaper than films. A substantial investment to become an applicator is unnecessary. With the liquid coating and a few low-cost tools, the all-in cost of the product will reflect the low cost of available labor in the particular country. Even greater cost advantage is possible when taking into account that applying IRUV Cut Coat requires less than half of the labor of affixing films. This product is well suited for developing countries and might provide additional demand for labor thereby complementing employment policies in many such countries.

12. **Serious Business Potential for Film Applicators, Glass Dealers, Remodeling Contractors and Painters.**

With the anticipated fall off in demand for new construction, the opportunities for developing a liquid coating application business may prove attractive to a variety of industry players including film applicators, painters and remodeling contractors. Glass dealers and installers may want to diversify their product offerings to include this option as well. For each of these participants, carrying these products brings a unique business opportunity.
### Comparison with Insulating Films and Glass

<table>
<thead>
<tr>
<th>Compared Products</th>
<th>IRUV Cut Coat</th>
<th>Reflective Film</th>
<th>Tinted Film</th>
<th>Transparent Heat-Absorbing Film</th>
<th>Shatter-resistant Film</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Solar heat gain coefficient</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
</tr>
<tr>
<td>2. Shading coefficient</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
</tr>
<tr>
<td>3. Thermal conductivity</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
</tr>
<tr>
<td>4. Reduced Insects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5. UV Reduction</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
</tr>
<tr>
<td>6. Visible Light Transmittance</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
<td>☑%</td>
</tr>
<tr>
<td>7. Appearance from Inside</td>
<td>Unchanged</td>
<td>Darkened</td>
<td>Darkened</td>
<td>Unchanged</td>
<td>Unchanged</td>
</tr>
<tr>
<td>8. Appearance from Outside</td>
<td>Good Visibility</td>
<td>Reflecting Reduced Visibility</td>
<td>No Visibility because of Tint</td>
<td>Good Visibility</td>
<td>Good Visibility</td>
</tr>
<tr>
<td>9. Glare</td>
<td>Same as Glass</td>
<td>Significant Increase</td>
<td>Significant Increase</td>
<td>Small Increase</td>
<td>Easily Damaged</td>
</tr>
<tr>
<td>10. Durability (in years)</td>
<td>☑~ ☑ Years</td>
<td>☑ Years</td>
<td>☑ Years</td>
<td>☑ Years</td>
<td>☑ Years</td>
</tr>
<tr>
<td>11. Price Per Square Meter</td>
<td>☑¥~ ☑¥</td>
<td>☑¥~ ☑¥</td>
<td>☑¥~ ☑¥</td>
<td>☑¥~ ☑¥</td>
<td>☑¥~ ☑¥</td>
</tr>
<tr>
<td>12. Surface Hardness</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>14. Shatter Resistance</td>
<td>No</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Intermediate</td>
<td>Yes</td>
</tr>
<tr>
<td>15. Application Method</td>
<td>Paint (simple)</td>
<td>Glue Film (difficult)</td>
<td>Glue Film (difficult)</td>
<td>Glue Film (difficult)</td>
<td>Glue Film (difficult)</td>
</tr>
<tr>
<td>16. Single Pane Glass</td>
<td>Possible</td>
<td>Impossible</td>
<td>Impossible</td>
<td>Impossible</td>
<td>Impossible</td>
</tr>
<tr>
<td>17. Seams</td>
<td>None</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
</tbody>
</table>

The method for calculating the incoming heat load for a glass window is:

\[
\text{Window Heat Load Factor} = (\text{Standard Radiation Gain}) \times (\text{shading coefficient}) \times (\text{area of the})
\]
window) X (number of cooling days)

1. Cost Comparison

The per meter product costs of the liquid insulating coating is but half of what films cost and the liquid coating may last up to three (3) times as long, giving a cost advantage for equivalent films of greater than 50%.

However, reflective and tinted films are much more effective in terms of the shading function as measured by the shading coefficient than insulating liquid coating and these two lower costs in the summer months. On the other hand, during the winter, our thermal insulating coat permits most of the visible light, which comprises 50% of the sun’s heat, to come through the window and warm the interior of the room. In contrast, reflective and tinted films are substantially worse letting in only 10~50% of the visible light, thereby significantly increasing heating costs. When considering year-round heating and cooling loads, the thermal insulating liquid coating reduces energy costs.

2. Reflection and Scenic Views

Restaurants, hotels and showrooms are often located to take advantage of night scenery and the reflection of such scenery can be fatal to those businesses, especially with tinted or reflective film reflects to a considerable extent. Hotels have a tendency to avoid reflective film because of their dislike of this reflection. Moreover, in Japanese municipalities reflective pollution is considered a growing problem and restrictions may be placed on the use of reflective glass and reflective films which will ensure that products with high visible light transmissivity, such as low-e glass, low-e film and thermal insulating glass coatings become the primary glazes for such buildings.

3. Durability

Films easily scratch because they are composed of PET. IRUV Cut Coat, however, exhibits superior durability because the primary ingredient of the base is silicon oxide which after hardening has the same composition as glass. In addition, the lifespan of a film greatly varies with the skill of the applicator while IRUV Cut Coat adheres firmly to the glass avoiding longevity issues.

4. Application

There may be some limitation on applying films to single pane glass. Moreover, buildings with large windows such as automobile show rooms and hotel lobbies will have seams every 5 feet with film products, but IRUV Cut Coat can be applied to single pane glass and even to large windows without seams for hotels, restaurants and showrooms where such seams may be considered a major obstacle to adopting such energy-saving technology.
5. Reduction in IR and UV Blocking

IRUV Cut Coat and films both block about the same amount of UV radiation, but considering the greater longevity of IRUV Cut Coat, it can be considered to block that amount of UV for up to three times as long.

The shading coefficient (SC) measures the amount of IR that is cut of the incoming solar radiation and the lower the number the more effective and energy efficient the film or coating is. Reflective films have the lowest SC followed by tinted films and then by IRUV Cut Coat which is in turn followed by transparent solar films. Viewing this feature in isolation, IRUV Cut Coat appears inferior to those products with lower SCs, but when account is taken of the reduced visible light transmission that is a feature of tinted and reflective films resulting not only in a loss of transparency, but also a reduction in the warmth that comes through during the winter of the infrared radiation that we sense as warm on the skin, viewed overall, the reflective and tinted films do not have much of a lead with respect to thermal performance during the summer months. (IRUV Cut Coat blocks 35% or more of the near infrared and 95% of the far infrared.) In contrast, during the winter months, IRUV Cut Coat is more effective than reflective or tinted film because it blocks the escape of interior heating (infrared).

Except for protection against shattering, IRUV Cut Coat emerges superior to the various types of films taking into account overall cost and functionality. Indeed, IRUV Cut Coat may be viewed as the most promising energy saving product in reducing global warming.